DOES CURRENT ARMY PHYSICAL FITNESS TRAINING DOCTRINE ADEQUATELY PREPARE SOLDIERS FOR WAR?

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The U.S. Army has continually adjusted its fitness regimen to best prepare Soldiers for combat. This paper attempts to answer a critical question: Does the current U.S. Army physical fitness training doctrine adequately prepare soldiers for war? Since 1941, FM 21-20, *Physical Training*, has been the sole source for fitness training. Outdated, it was replaced in March of 2010 by *Army Physical Readiness Training* (PRT). FM 21-20 does, however, contain building blocks of successful fitness programs. These will be used to compare the new PRT program with 2 alternative programs. The 3 programs will also be compared on the basis of muscle recruitment to execute 10 movements identified as critical by Training and Doctrine Command (TRADOC). Through this combined analysis, this paper will demonstrate which program best meets the evaluation criteria and trains the requisite muscles to execute the 10 movements. In conclusion, the reader will know whether the current U.S. physical fitness training doctrine best prepares soldiers for war.

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The opinions and conclusions expressed herein are those of the student author and do not necessarily represent the views of the U.S. Army Command and General Staff College or any other governmental agency. (References to this study should include the foregoing statement.)

ABSTRACT

DOES CURRENT ARMY PHYSICAL FITNESS TRAINING DOCTRINE ADEQUATELY PREPARE SOLDIERS FOR WAR, by Major C. Thomas, 134 pages.

The U.S. Army has continually adjusted its fitness regimen to best prepare Soldiers for combat. This paper attempts to answer a critical question: Does the current U.S. Army physical fitness training doctrine adequately prepare soldiers for war? Since 1941, FM 21-20, *Physical Training*, has been the sole source for fitness training. Outdated, it was replaced in March of 2010 by *Army Physical Readiness Training* (PRT). FM 21-20 does, however, contain building blocks of successful fitness programs. These will be used to compare the new PRT program with 2 alternative programs. The 3 programs will also be compared on the basis of muscle recruitment to execute 10 movements identified as critical by Training and Doctrine Command (TRADOC). Through this combined analysis, this paper will demonstrate which program best meets the evaluation criteria and trains the requisite muscles to execute the 10 movements. In conclusion, the reader will know whether the current U.S. physical fitness training doctrine best prepares soldiers for war.

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ACRONYMS

AAR	After Action Review
AR	Army Regulation
APFT	Army Physical Fitness Test
APRT	Army Physical Readiness Training
ARFORGEN	Army Force Generation
BCT	Basic Combat Training
BFT	Battle Focus Training
CD	Conditioning Drill
CL	Climbing Drill
CAC	Combined Arms Center
CFT	Combat Fitness Test
COE	Contemporary Operating Environment
FLOT	Forward Line of Troops
FM	Field Manual
GD	Guerilla Drill
HRE	Heavy Resistance Exercise
HRR	Heart Rate Reserve
IET	Initial Entry Training
ILE	Intermediate Level Education
IMT	Initial Military Training
METL	Mission Essential Task List
MHR	Maximum Heart Rate
MMA	Mixed Martial Arts

MRAP	Mine Resistant Ambush Protected
NCO	Non-Commissioned Officer
NCOES	Non-Commissioned Officer Education System
OES	Officer Education System
OPTEMPO	Operational Tempo
OSHA	Occupational Safety and Health Administration
OSUT	One Station Unit Training
PRT	Physical Readiness Training
PSD	Push-Up/Sit-Up Drill
RHR	Resting Heart Rate
STC	Strength and Training Ciruit
TC	Training Circular
THR	Training Heart Rate
TTP	Tactics, Techniques, and Procedures
USAPFS	United States Army Physical Fitness School
USMA	United States Military Academy
WTBD	Warrior Tasks and Battle Drills

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CHAPTER 1

INTRODUCTION

United States Army doctrine places a premium on the direct impact physical fitness has on mission readiness. The preface in Field Manual 21-20, *Physical Fitness Training*, illustrates this connection with a synopsis of the fate of Task Force Smith early in the Korean War. Meant as an "arrogant display" of military strength, the 540 poorly trained and ill-prepared members of the task force were quickly routed by North Korean forces just north of Osan (Military.com 2010).

The concept of train as you fight was either not yet in fashion or the U.S. Occupation Forces in Japan determined speed was more critical than prudence. Has the U.S. Army corrected this deficiency and adequately addressed the correlation between effective physical training and success on the battlefield?

The most recent version of the United States Army's capstone training regulation, Army Regulation (AR) 350-1, Training, Army Training and Leader Development, states that a unit's physical training program should be based, "on the unit's most physically demanding tasks, the program should incorporate activities such as foot marching short distances (3-5 miles) under fighting load, lifting and loading equipment, conditioning for obstacle course negotiation and individual movement techniques" (U.S. Department of the Army 2009b, 13).

Given the two major theaters of conflict in which the U.S. Army is currently fighting, this focus on mission-oriented physical training makes sense. Field Manual (FM) 21-20, cited in AR 350-1 as the sole source for physical training, may not be as forward thinking as the overarching training regulation. Last updated in October of 1998,

"FM 21-20 was written to conform to the principles outlined in FM 25-100, Training the Force" (U.S. Department of the Army 1998, ii).

FM 25-100, *Training the Force*, became obsolete with the introduction of FM 7-0, *Training the Force*, in October 2002. FM 7-0 was subsequently updated and re-titled in December 2008 as Training For Full Spectrum Operations. The newest FM 7-0 "addresses the fundamentals of training modular, expeditionary Army forces to conduct full spectrum operations--simultaneous offensive, defensive, and stability or civil support operations--in an era of persistent conflict" (U.S. Department of the Army 2008c, iii). Although many of the foundational principles of physical fitness remain unchanged, how they are applied and incorporated in modern training may require modification.

Whether to change the current training regimen or maintain the status quo has two sides, though. There are fewer voices openly praising the current physical fitness training system as outlined in FM 21-20, but even the detractors cite reasons why change may not be necessary. These individuals cite much of the same reasoning that went into the development of the current PT system and its accompanying Army Physical Fitness Test (APFT). Major Michael Long's recent Combined Arms Center (CAC) blog, *Modernization of the APFT,* specifically comments on the testing aspect of the Army's physical training program. His comments are representative of other blogs, articles and in professional military publications. "Probably the best reason for keeping the current APFT is the fact that it is very easy to conduct. NCOs can administer the APFT in relatively any location that can accommodate a little floor or ground space for pushups and sit-ups and any length of space that can be used as a running track, primarily roads.

Army leaders do not feel the need to change something that seemingly already works" (Long 2010).

In his reply to Major Long's post, Major Matt Dennis identified a common reason supporting changes to the current system. "focusing solely on improving APFT event scores may have little impact on the fitness required to accomplish the mission assigned" (Dennis 2010). Mr. H. David Pendleton also replied, but cautioned against possible pitfalls of a new system. It should not require too much equipment or time to execute with larger groups, require too much training to properly conduct the events, or focus too much on unit average scores and overshadow valuable unit physical readiness feedback for the commander" (Pendleton 2010).

Prior to the events of 11 September 2001, the U.S. Army had begun focusing research on a new standardized method of training called Physical Readiness Training (PRT). The U.S. Army Physical Fitness School (USAPFS) developed a program that shifted focus from a peacetime army training for generic physical fitness to an army training to perform combat tasks. This program is outlined in the new Training Circular (TC) 3-22.20, *Army Physical Readiness Training* (PRT) and will be covered in depth in a later chapter. The 2009 Army Posture Statement describes PRT as a "shift from training for the Army Physical Fitness Test (APFT) to training that focuses on combat specific tasks" (U.S. Department of the Army 2009a, 1).

Now complete, TC 3-22.20 replaces doctrine that was timely and applicable when President Jimmy Carter was still in office. According to Mr. Frank Palkosksa, Director of the U.S. Army Physical Fitness School (USAPFS), the new TC 3-22.20 is complete and the electronic version is available on the USAPFS website.

Although it may be months before the print version of TC 3-22.20 is published, the United States Army's initial steps to address standardized physical training for initial entry training (IET) personnel have been approved and published. The new Standardized Physical Training (SPT) Guide was published in January 2005 and addresses "the use of multiple training activities to achieve balance in the PT program and appropriate recovery between PT activities. Because most common soldier tasks require a blend of strength, endurance and mobility, PT sessions are designed to challenge all three components in an integrated manner" (U.S. Department of the Army 2005, 12).

This SPT training philosophy may seem like a new concept to some, but actually has very long roots reaching back to physical training philosophies in use long before the U.S. Army adopted a standardized physical regimen.

Background

"Fatigue makes cowards of us all" (GEN George S. Patton). In December 1944, the men of E Company, 506th Regiment, 101st Airborne lay in fighting positions in the Ardennes Forrest just outside of Bastogne, Belgium. They faced fifteen German divisions, four of which were armored. These divisions were supported by heavy artillery that continuously shelled the American positions previously held by German infantry.

E Company endured bitter cold temperatures, inadequate medical supplies, and ran dangerously low on both food and ammunition as they fought to hold the Allied line against the German counterattack in the Battle of the Bulge. Captain Gerd von Fallois, a German tank commander outside Bastogne summed up the Americans' rugged determination best, "The Americans were extraordinarily brave. It was amazing what

their troops were accomplishing. I knew we wouldn't get any farther than Bastogne" (Suerth 2009).

Their indomitable fighting spirit and perseverance can be traced back in part to the excellent physical training they received at Camp Toccoa, Georgia. There, in the summer of 1942, they hardened themselves running up and down Currahee Mountain and broke the world march record held by the Japanese Army. "Here men trained at 12-hour days doing push-ups, pull-ups, squat jumps and various other exercises designed to strengthen arms and legs and increase overall endurance. The men ran Currahee several times a week and then made long force marches at night. Also, the men were to go through the roughest obstacle course in the U.S. Army" (Suerth 2009).

The terrain and the enemy may have changed some 67 years later, but the need for hard, battle focused training (BFT) is just as important. This thesis seeks to determine if current Army doctrine adequately represents "Currahee" for our Army at war, or if there is a need to climb another mountain.

Problem Statement

Physical demands placed on Soldiers have increased exponentially in the past 8 years. The increased operational tempo (OPTEMPO), deployment frequency, harsh environments and unforgiving terrain have all combined to take a toll on today's deploying force. This study will examine whether current Army physical training programs adequately address the physical training needs of U.S. Army forces. The U.S. Army is in a bridging period from old doctrine to proposed new doctrine. TRADOC has identified 10 critical movements for all initial entry training (IET) personnel: Lifting from the ground, Lifting overhead, Pushing, Pulling/Climbing, Rotation, Jumping and

Landing, Lunging, Marching, Running, and Change direction. Do the factors of strength, endurance, mobility, precision, progression, integration, and principles of exercise outlined in current Army doctrine adequately train these movements and address the physical fitness needs of an Army at war? Is the new PRT proposed better able to train soldiers for the physical demands of war? Is Army doctrine off-course all together? Should more components of cutting edge commercially available programs be adopted in physical training doctrine?

Definitions

The study and discussion of physical fitness training programs and exercise physiology utilize vocabulary that is not common to everyday conversation. Some terms below are fairly common and are included only in the attempt to be complete. The less familiar terms are included not only to identify their meaning and enable discussion of more complex processes, but also to firmly establish a singular definition where several may exist.

Aerobic Endurance: The efficiency with which the body delivers oxygen and nutrients needed for muscular activity and transports waste products from the cells. Aerobic exercises include long distance running, biking, and foot marching.

Agility: The ability to stop, start, change direction, and efficiently change body position.

Anaerobic Endurance: The ability to extend anaerobic effort or the body's anaerobic threshold. The anaerobic threshold is generally regarded as the point when blood lactate starts to rise sharply, indicating that aerobic pathways are no longer

adequate to sustain the activity. Anaerobic activities include sprinting, soccer, and basketball.

Balance: The ability to maintain equilibrium.

Combat-Focused Physical Training: Physical fitness training that enhances soldiers' ability to complete critical functional movements.

Combat Physical Readiness: The ability to endure physical hardship, withstand stress and carry on under difficult and demanding situations. It also includes the ability to perform arduous, complex, and often explosive physical tasks not demanded during peacetime.

Coordination: The ability to perform multiple tasks.

Endurance: The ability to sustain activity.

Flexibility: The ability to move the joints or any group of joints through an entire, normal range of motion. Flexibility is essential in performing quality movements safely.

Functional Fitness: Includes agility, balance, coordination, and numerous other physical parameters.

Integration: Using multiple training activities to achieve balanced, appropriate recovery between activities.

Mobility: The functional application of strength and endurance. Movement proficiency.

Muscular Endurance: The ability of a muscle or group of muscles to perform repeated movements with less than maximum force for extended periods of time.

Muscular Strength: The greatest amount of force a muscle or group of muscles can exert in a single effort.

Posture: Any position in which the body resides.

Power: The product of strength and speed.

Precision: The strict adherence to optimal execution standards.

Progression: The systematic increase in the intensity, duration, volume and difficulty of activities.

Speed: Rate of movement. Speed is improved through perfection of technique and conditioning.

Stability: The ability to maintain or restore equilibrium when acted on by forces trying to displace it.

Strength: The ability to overcome resistance.

Stress: To subject to pressure or strain. Can impede physical and mental processes and performance.

Assumptions

The main assumption in the development of this thesis is that the U.S. Army is correctly and successfully transitioning from a training-based physical fitness program to a battle-focused training (BFT) program. Concurrently, this study assumes the Army has accurately identified the functional movements that initial entry soldiers must be able to adequately execute to perform their combat missions. These include: Lifting from the ground, Lifting overhead, Pushing, Pulling/Climbing, Rotation, Jumping and Landing, Lunging, Marching, Running, and Change direction. Although all 10 functional movements described in this thesis may not be required at all times in all military occupations, they collectively represent the best set of physical tasks common to all. This thesis also assumes there are exercises and collections of exercises that, when properly

trained, either accurately replicate these functional movements or effectively work the same muscle(s) required to perform these physical tasks. Finally, this study assumes that units are developing physical training programs in accordance with the principles and components outlined in current Army doctrine.

Limitations

The basis for comparison of alternate physical training programs will be limited to the criteria as outlined in phase two of my research. A scientific comparison of the results of controlled groups participating in the studied fitness programs would yield the best results, but time will not allow it. There are an infinite number of different fitness programs available for evaluation and comparison. This study will focus on the three programs identified in phase three of research design. Military data for historical context, program development and focus, and published results will be limited to Army and Marine programs. Air Force and Navy programs are still in their respective infancies and do not provide enough data to be useful.

Importance

As the U.S. Army continues to adapt to the contemporary operating environment (COE) in its organization, preparation and application of forces to prosecute the long war(s), physical fitness presents a unique opportunity that separates it from other skill sets. Physical Training is the one activity over which company level leadership has complete control, directly affects the health and welfare of soldiers, and better enables them to accomplish their mission.

Unlike past conflicts, when major combat operations along the front lines and the forward lines of troops (FLOT) were the main focus, physical excellence is no longer solely applicable to combat troops. Physical excellence must now extend through the depth of our forces. In today's COE "subordinate units routinely operate in noncontiguous areas of operations. This contrasts sharply with the contiguous and hierarchical arrangement of land forces in operations prevalent in the past" (U.S. Department of the Army 2008b, C-1).

It is no longer just maneuver, fire and effects units who must shoulder the load of direct contact with the enemy. Combat supporters and combat service supporters are also defending what equates to a 360-degree continuous perimeter. Reports and after action review (AAR) comments from both Afghanistan and Iraq note the importance not only of physical preparation prior to deployment, but also of continuing physical training programs while deployed. "This terrain can break you physically and mentally. Train to be hard physically and mentally. Teach them how to think under duress in dealing with terrain and key leader engagements" (Company Command Team 2009a, 69). "Physical fitness helps keep your mind sharp, staves off depression, keeps soldiers occupied, and helps keep soldiers acclimated to the heat. If you don't do PT, your soldiers will go down with injuries, heat exhaustion, and become over stressed with no release"(Company Command Team 2008b, 12).

Aside from the obvious benefits of higher levels of physical stamina in austere and demanding environments, the mental benefits from physical fitness are also immeasurably beneficial. Soldiers must not only arrive at the objective with all the necessary equipment to accomplish their mission, they must also be able to cognitively

function and make good reasoned decisions under duress. A recent Reuters Health article cites the work of Dr. H. Georg Kuhn and associates at the Institute of Medicine at the University of Gothenburg in Sweden. Dr. Kuhn's study suggests a link between increased cardiovascular fitness and intelligence. "Male subjects with improved predicted cardiovascular fitness between 15 and 18 years of age exhibited significantly greater intelligence scores than subjects with decreased cardiovascular fitness," Kuhn and colleagues report in Proceedings of the National Academy of Sciences (Lowe 2009).

Any activity under direct control of company level leadership that develops the entire body including the soldier's mind necessitates careful review, detailed analysis and insightful application.

CHAPTER 2

LITERATURE REVIEW

Reports and feedback from both Iraq and Afghanistan testify to the importance of combat-focused physical training both prior to deployment and during the tour as feasible (Insights from Company Commanders in Iraq 2008; Afghan Commander AAR Book Currahee Edition 2009). Chapter 1 broaches the topic of ensuring a tangible link between tough, combat focused physical training and the demanding requirements faced in current operational theaters. This thesis seeks to determine whether the current U.S. Army Physical Fitness Training program adequately addresses the physical fitness needs of an Army at war. This review will identify the sources utilized and discuss their relevance in the research and construct of this thesis. These materials will fall into four basic categories: historical publications and doctrine, unpublished military sources, alternative training programs and exercise physiology information.

Historical Publications and Doctrine

The historical publications researched for this thesis are a series of documents that developed into current physical fitness doctrine. They are included to provide background information on the evolution of U.S. Army physical fitness training doctrine. The culmination of this evolution, United States Army Field Manual (FM) 21-20, *Physical Fitness Training*, is the sole reference for planning, conduct, and assessment of physical fitness training in the Army. It will be used as a basis for comparison of the other programs addressed in this thesis. Although initially introduced in 1941 and subsequently modified and updated, FM 21-20 traces its history back to prior to the turn of the century.

It was 1892 and the United States Military Academy (USMA) was to be instrumental in the first production of a codified physical fitness program for the Army, the *Manual of Calisthenic Exercises*. The USMA Superintendent at the time, COL John M. Wilson, had noticed the "wonderful effect upon the carriage and bearing of the younger cadets of the calisthenic exercises as developed by Mr. Koehler" (War Department 1892, V).

The Mr. Koehler he referred to was Herman J. Koehler, Swordmaster at the USMA. As Swordmaster, Mr. Koehler was not only responsible for instructing the exercise program at the academy, but was also revolutionary in the USMA's physical program development. He believed in "simple exercises and combinations of exercises, arranged progressively, to develop muscular strength, activity, grace, and agility" (Reagor 1998, 11). He was also the first to establish height and weight standards for USMA cadets, modifications of which are still in use today.

Koehler was also involved in the development of the next military publication addressing military physical fitness training, *Manual of Physical Training*, published in 1914. LTC Fred Sladen, then CPT Herman Koehler and 1LT Philip Mathews teamed up to refine Koehler's earlier work. Chief of Staff of the Army, MG Leonard Wood had taken a particularly keen interest in not only the development of a comprehensive physical training program, but also its regulated utilization in Army units. In the foreword of the Manual of Physical Training, MG Wood stated, "There is nothing in the education of the soldier of more vital importance than this, and while considerable has been accomplished by some commands in this respect in the past it has . . . lacked system and uniformity" (War Department 1914, 3).

Improving on the Manual of Calisthenic Exercises, The Manual of Physical Training summed up the objectives of physical training in order of importance as: general health and bodily vigor, muscular strength and endurance, self-reliance, and smartness, activity and precision. For the first time the manual also addressed the need to attain levels of physical fitness beyond basic good health. Speaking of the professional soldier the manual states, "His profession demands that he possess more than the average amount of muscular strength and endurance in addition to good health, in order that he may be ready to exchange the comparative comforts of barrack life for the hardships of field service at any moment without diminishing his effectiveness" (War Department 1914, 5).

After nearly three years of fighting in World War I, The U.S. Army had collected ample feedback on the effectiveness of its physical training program in preparing soldiers for combat. The cursory acknowledgment of the necessity to link physical training to preparation for war was further clarified in the 1917 publication, *Field Physical Training of the Soldier*. The first full page of text in Section I was much more direct and to the point than the language used in prior publications. Paragraphs two and three of Section I speak directly to the demands of modern warfare and the necessity for physical training, "The trained man has up to the present time demonstrated his ability to hold his own against the most terrible odds successfully; and in the end it will be discovered that it is the *man*, the carefully trained and conditioned man, who alone can make victory possible. Physical training, development, and conditioning of those recruited for the military service must be the first and most important concern of a nation at war" (War Department 1917, 7).

Accompanying this direct language was a refined list of proposed activities for training also tempered by war: Setting up exercises, Marching and exercising in marching, Double timing and exercises in double timing, Jumping, Rifle exercises, Bayonet exercises, Vaulting and overcoming obstacles, Athletic games and contests (War Department 1917, 9). Necessity is often the mother of invention and a battle-focused approach to physical training was a natural progression.

The more things change, the more they remain the same.
-Alphonse Karr

The U.S. Army made its initial attempt to develop and employ an organized physical training program nearly 118 years ago. One of the main facts driving that program development and all subsequent improvements has remained unchanged; the majority of soldiers entering the U.S. Army do not possess the requisite physical fitness levels to most effectively perform their duties in combat. This has been the case since the U.S. Army's birth in 1775. At no time was this fitness deficiency more apparent than at the end of the Civil War. CPT Michael Reagor addressed this topic in his paper discussing the establishment of the physical training program at the United States Military Academy at West point, "Reports of the poor physical condition of over a million Civil War recruits resulted in a renewed drive for military and physical training in schools" (Reagor 1998, 7).

Today's officers and non-commissioned officers face the same challenge. Soldiers held to substantially lower standards on the current Army Physical Fitness Test (APFT) graduate Initial Entry Training (IET) and join units preparing to deploy. These lower standards are most prominent in the youngest demographic, 17-21 year olds. According

to FM 21-20 standards, in 1992 male and female soldiers were expected to perform, respectively, 82 and 76 push-ups, and 92 and 90 sit-ups to achieve the maximum score of 100 in those events. In the 1998 revision of FM 21-20 these requirements dropped to 71 and 42 push-ups for males and females, and 78 sit-ups for both males and females to achieve the same scores of 100 in each event. Similar relaxing of the standards affected the two-mile run requirements during the same time period. In 1992 times of 11:54 for males and 14:54 for females were required to achieve a perfect score of 100. These times increased to 13:00 and 15:38 in 1998. The minimum standards, 60 points per event, remained relatively unchanged from 1992 to 1998. The one notable change in the minimum requirement was in the sit-up category. Sit-ups actually increased from 52 for males and 50 for females, to 71 for both males and females. These scoring changes on the Army Physical Fitness Test (APFT) and reorganization of the age groups for the alternate PT test are the only FM 21-20 updates from 1992 to 1998. As the sole physical training resource, the current version of FM 21-20 is an effective tool for the construct of a basic physical fitness program. What it lacks is the detail to provide a quick, one-stop resource for leaders to easily determine key combat tasks to train and specific exercises to address these tasks. Chapter 10, Developing the Program, outlines the seven step planning process: Analyze the Mission, Develop Fitness Objectives, Assess the Unit, Determine Training Requirements, Design Fitness Tasks, Develop a Training Schedule, and Conduct and Evaluate Training (U.S. Department of the Army 1998, 10-1 to 10-3). This is a complete outline that identifies the basic steps for developing a program, but it is so generic that it could just as easily be utilized to solve any problem set. It lacks the detail necessary to make it useful. Chapter 5 Body Composition, Chapter 6 Nutrition and

Fitness, and Chapter 13 Injuries similarly lack the requisite specificity for a sole source document. Pearls of wisdom such as, “A combination of exercise and diet is the best way to lose unwanted body fat” (U.S. Department of the Army 1998, 5-1). “Avoiding an excessive intake of fats is an important fundamental of nutrition.” (1998, 6-3) and “Many running injuries can be prevented by wearing proper footwear.” (1998, 13-2) take up margin space while providing little added value. FM 21-20 has “good bones” as a source document, but requires more meat to be useful to soldiers and leaders.

FM 3-22.20, *Army Physical Readiness Training* (APRT), discussed briefly in Chapter 1, may have added the necessary meat that soldiers and leaders have been looking for. In its draft form the APRT appears to address many of the perceived deficiencies of the FM 21-20 series. Some of these are highlighted immediately on the Introduction page:

> [This manual] reflects lessons learned in battles past and present, time-tested theories and principles, and emerging trends in physical culture. Prepares Soldiers physically for full spectrum operations. Allows leaders to adapt PRT to unit missions and individual capabilities. Provides a variety of PRT activities that enhance military skills needed for effective combat and duty performance. (U.S. Department of the Army 2010, xix)

Similar to its FM 21-20 series predecessors, APRT is adamant in its declaration that physical training directly contributes to a soldier’s ability to effectively perform his combat duties. It also cites the current regulations and doctrine on which it is not only based, but also mutually supports in its design, organization and execution. Army Regulation (AR) 350-1, *Army Training and Leader Development*, lays the groundwork for the PRT concept and “specifies that Physical Fitness Training (PRT) is one of the Army’s mandatory training requirements” (U.S. Department of the Army 2010, 1-1). The APRT is also inextricably linked to FM 7-0, *Training for Full Spectrum Operations*. It

utilizes the same seven principles of training outlined in FM 7-0: Commanders and Others are Responsible for Training; Noncommissioned Officers Train Individuals, Crews and Small Teams; Train as You Will Fight; Train to Standard; Train to Sustain; Conduct Multi-echelon and Concurrent Training; and Train to Develop Agile Leaders and Organizations (U.S. Department of the Army 2008c, 2-1). As such the proposed APRT not only suggests, but also requires that physical training standards be developed only after careful consideration of both Mission Essential Task Lists (METL) and Warrior Tasks and Battle Drills (WTBD). The APRT goes on to provide analysis of WTBD and breaks down both the physical requirements necessary to train them, and the PRT components and activities that are addressed and utilized. The final paragraph of the first chapter of the APRT best summarizes its purpose and applicability to this thesis:

> This TC provides Soldiers and Leaders with the doctrine of the Army Physical Readiness Training. It is a product of our history, forged out of the great battles from the past to the present. Its doctrinal concepts also reflect emerging trends in current physical culture. This TC will impact the army in a manner of importance toward the continuation of our national strength and security. The purpose of the Army PRT is not merely to make our Soldiers look fit, but to actually make them physically ready for the conduct of full spectrum operations. (U.S. Department of the Army 2010, 1-9)

Unpublished Military Sources

A few Military Master of Arts and Science theses and monographs have explored different aspects of the U.S. Army physical training program and how its results can and should be measured. Each approached the topic from a different angle and point of view, but the central theme of each was similar. Each explored whether the U.S. Army was utilizing the proper measure of physical fitness. Was the Army Physical Fitness Test (APFT) an accurate assessment of physical fitness as it applied to results on the battlefield? This thesis differs in that it explores the training that takes place prior to the

physical fitness assessment. Does the U.S. Army physical training program address the key physical movements required to adequately perform combat tasks regardless of duty description? Four of these previously completed theses were reviewed while researching this thesis to understand previous work, gain knowledge on research conducted on the topics, and to access additional sources.

A 2008 thesis by MAJ James E. Batchelor entitled *The Applicability of the Army Physical Fitness Test in the Contemporary Operating Environment* investigated the utility of the current Army Physical Fitness Test (APFT) in determining Soldier combat readiness. MAJ Batchelor dissected the muscle movements required to conduct three sets of of tasks: (1) the three events in the APFT; pushups, sit-ups and the two-mile run, (2) combat tasks as identified by Training and Doctrine Command (TRADOC), and (3) the top six combat tasks identified in a survey of Intermediate Level Education (ILE) majors. These three sets of tasks were then compared on the basis of the required body movements and the specific muscle(s) involved. It was MAJ Batchelor's conclusion that the APFT was inadequate to measure the necessary elements of functional movement as identified in both the TRADOC tasks and top six tasks identified in his ILE survey. The three APFT events in FM 21-20 utilized to determine physical fitness do not utilize many of the same requisite body movements necessary to complete both the TRADOC tasks and those tasks recorded in the ILE survey. What the APFT was measuring was not true combat physical fitness.

A second thesis written in 2001 by MAJ Frederick Mark O'Donnell, *Physical Training Programs In Light Infantry Units: Are they Preparing Soldiers For The Rigors Of Combat?*, addressed a similar topic. Although focused solely on light infantry physical

training, parallels can be easily drawn between other branches and mission operation specialties. MAJ O'Donnell determined that while light infantry units successfully trained most of the physical readiness components outlined in current doctrine, "motor efficiency and mobility were shown to be almost non-existent in unit programs" (O'Donnell 2001, 99). He also identified an elevated focus on running to the detriment of other means of training aerobic endurance. Although not the focus of his thesis, he also identified a lack of variety in unit programs. The events measured during the conduct of the APFT were over-represented in weekly training, most of which are single plane movements. In addition to becoming monotonous this, most likely, is what leads to the lack of mobility and motor efficiency development. The 10 critical movements identified for IET personnel combine numerous single plane movements into complex movements. Training the individual movements independently rather than as complex collections of movements precludes development of necessary motor efficiency and mobility. Strength and endurance are also critical, but must be applied as part of complex functional body movements in order to effectively execute critical combat tasks.

In 1997 MAJ Mark R. Forman completed his monograph, *Too Fat to Fight - Too Weak To Win, Soldier Fitness In The Future?* In it MAJ Forman argues that the current Army physical fitness program is incapable of producing the quality of combat arms soldiers required. He suggests that, "The false notion that advancements in mechanization and automation will significantly reduce individual muscular strength requirements persists today" (Forman 1997, 16). Like MAJs O'Donnell and Batchelor after him, he found a disconnect between what was being trained and measured during physical training, and the tasks soldiers were being asked to perform in combat. He did suggest,

though, that the APFT is useful as a measuring stick for new recruits and should be utilized to screen them prior to their enlistment. Although the focus of his thesis and current recruit screening programs differ extensively, some of MAJ Forman's suggestions can be found in the Initial Entry Training physical training guidance now taught to all prospective U.S. Army recruits.

The final monograph reviewed was written by MAJ Mark Phillip Hertling in 1987. In *Physical Training for the Modern Battlefield: Are We Tough Enough?*, MAJ Hertling explored the physiological effects of fear and fatigue on soldiers. Much of his supporting evidence was gleaned from the mission-specific training programs employed by everyone from the Suzdal Regiment Commander, Alexander Suvorov in 1762 to MG Lucian Truscott during WWII. Although dated in applicability of cited doctrine by some 22 years, it is interesting that MAJ Hertling was asking some of the same questions raised in the previously reviewed works as well as this thesis; "Is the aerobic-intensive, PT-test oriented, "corporate fitness" training concept prescribed by our army best suited to prepare soldiers for the battlefield? Unfortunately, no" (Hertling 1987, 3). What is equally interesting is that he and many others asked that question so long ago and only now is U.S. Army physical training doctrine addressing the identified shortcomings in a substantial way. A quote by General Alfred Gray, incoming Commandant of the Marine Corps in 1987 and cited by MAJ Hertling in his thesis sums it up best:

> There are those who pride themselves on the number of push-ups, sit-ups and chin-ups they can perform, but no one has stressed how they can carry a wounded Marine the length of the parade ground without killing him. That is what we should know and be able to do. If some want to run in their silk shorts and Addidas that's fine with me; but the Corps is going to return to Physical Readiness Training vs. physical fitness. (Hertling 1987, 41)

Alternative Training Programs

A quick internet search for “fitness programs” or “physical training programs” will produce more training regimens than could realistically be attempted in a lifetime. Of the nearly infinite number of available programs, this thesis compared two of the most popular commercially available training programs, CrossFit and P90X, to the U.S. Army’s current physical training program. These two programs are also the most popular among U.S. Army personnel as an adjunct to required military fitness training according to numerous fitness and military blogs.

Unlike most popular fitness programs that stress specificity and focus on particular muscle groups, CrossFit takes a decidedly different tack. “CrossFit is a core strength and conditioning program that specializes in not specializing” (Glassman 2009a). Its goal, as Coach Greg Glassman, CrossFit creator, explains it: “CrossFit is not a specialized fitness program but a deliberate attempt to optimize physical competence in each of ten recognized fitness domains. They are Cardiovascular and Respiratory endurance, Stamina, Strength, Flexibility, Power, Speed, Coordination, Agility, Balance, and Accuracy” (Glassman 2009b). Five of these domains are identical to the components of fitness contained in FM 21-20. CrossFit also addresses the Frequency, Intensity, Time, and Type (FITT) principles and the principles of exercise: Regularity, Progression, Balance, Variety, and Recovery. Notably absent is the principle of Specificity. Most exercise regimens concentrate on specific body parts to promote their growth and development. Similarly, they focus on the specific muscle groups and physical movements required to excel in a particular sport or activity. As stated earlier, CrossFit’s approach discourages specificity and encourages a holistic fitness that improves overall

physical performance. CrossFit also places a premium on eating well and identifies nutrition as the base for any true training program. Where CrossFit differs with FM 21-20 is how it maximizes results utilizing not only its ten components, but also its defining themes. The four defining themes of CrossFit are Neuroendocrine Adaptation, Power, Cross-Training, and Functional Movements. Neuroendocrine adaption is the increased release of key hormones and neurological changes in response to heavy resistance exercise (HRE). Power, as defined in chapter one, is the product of strength and speed. CrossFit seeks to increase power daily. To put it simply, completing a workout faster and to an increasingly difficult standard is better. Cross training speaks to the very essence of CrossFit's pursuit of broad based fitness utilizing methodologies ranging from yoga and gymnastics to weight lifting and rowing. Functional movements replace the isolation movements predominant in typical gym workouts. Instead of biceps curls CrossFit utilizes several variations of palm facing chin-ups. Rather than leg curls CrossFit utilizes squats. These functional movements are safer because they employ ranges of motion in which joint and muscular pairings naturally function. This facilitates power generation and a more rapid neuroendocrine adaptation. The CrossFit program addresses all the principles outlined in the Army's current doctrine, FM 21-20, while paralleling many of the new foci in the Army's proposed doctrine, TC 3-22.20.

Similar to the CrossFit program, P90X training also attacks the body from several angles. Variations of intense and focused workouts keep muscles in a state of confusion, which is the key to the P90X program. This constant variation of exercises and resulting "muscle confusion" (Horton 2008, 1) combats boredom and keeps the body from plateauing. Trainer to the stars turned home fitness guru, Tony Horton, utilizes a

collection of twelve different workouts: Chest and Back, Plyometrics, Shoulders and Arms, Yoga X, Legs and Back, Kenpo X, X Stretch, Core Synergistics, Chest-Shoulders and Triceps, Back and Biceps, Cardio X, and Ab Ripper X (Horton 2008, 7-8). The individual workouts will be discussed in detail during the analysis of the different programs in chapter three. The twelve workouts are further organized into three distinct training blocks. These blocks consist of three weeks of intense training followed by one week of recovery. Within each of these three blocks are three distinctive phases: Adaptive Phase, Mastery Phase, and Recovery Phase. During the adaptive phase the body learns new exercises and movements. In the mastery phase the body responds to the exercises and begins to change. Finally, in the recovery phase, the body heals, grows stronger, and prepares for the next round of confusion (Horton 2008, 3-4). These three training blocks of four weeks combine for a total of 90 days giving us the name of the program. P90X also places great importance on nutrition and produces several P90X brand supplements as well as recommending additional supplements produced and sold by the parent company of P90X, Beachbody. Unlike CrossFit, P90X is completely home-based and does not require any heavy lifting equipment to get the full training effect. What are required are the 12 DVD workout system, a DVD player and television to play them, and dumbbells. There are several other recommended products ranging from yoga mats to resistance bands that would enhance the workout, but are not required. Although differing from CrossFit in its approach, P90X also bridges the gap between FM 21-20 and TC 3-22.20 by addressing the principles of fitness and the FITT principles.

Upon initial inspection, these programs appear to address some of the shortcomings of the U.S. Army's current physical training program. This thesis will

determine to what extent these perceived improvements directly translate into projected efficient conduct of battlefield tasks. Also key in comparing these programs is the understanding of the muscles and groups of muscles necessary to complete key movements. Several sources helped illustrate the location and physical relationship of these muscles and movements by providing a roadmap of human musculature.

Exercise Physiology Information

Anatomy of Exercise: A Trainer's Inside Guide To Your Workout (Manocchia, 2008), Exercise Physiology: Theory and Application to Fitness and Performance (Adams, Howley, Powers 2006), and Anatomy for Strength and Fitness Training (Vella 2006) served as the primary sources for basic fitness anatomy and physiology. Even simple exercises in physical training require the orchestration of numerous active muscles, stabilizing muscles, deep muscles, and joint articulations. The common push-up requires the interaction of 21 different muscles to execute one repetition. The overhead press requires the coordination of 28 separate muscles. Knowledge of individual muscles and muscle groups is vital to understanding the basic mechanics involved in the functional movements that will be evaluated. These sources provided detailed explanations of the many single plane movements within the complex functional movements. The majority of the exercises described and depicted in these sources were those found in traditional gym-based training programs. It was necessary to break down the complex functional movements into collections of the requisite single plane movements to identify the required muscles and muscle groups. This knowledge will allow a side-by-side comparison of the muscle(s) involved in the exercises utilized in each of the different systems and provide a standard basis of reference.

This chapter has provided an overview of the different types of literature sources addressing not only the U.S. Army's current physical training program, but also proposed changes in its doctrine. It addressed the history and evolution of current U.S. Army physical training doctrine, prevailing attitudes of leaders currently deployed in combat theaters, and introduced a small sample of the myriad commercially available programs that leaders and soldiers consider as adjuncts to U.S. Army physical training. While all the literature provides background and context, the Army's current physical training doctrine, FM 21-20; it's proposed replacement sole source document, TC 3-22.20; and the sample of currently available commercial training programs are the most important. They provide the fundamental principles, methods of training and differing foci that will be compared and contrasted within the framework of analysis established in the next chapter.

CHAPTER 3

RESEARCH METHODOLOGY

Chapter 1 identified historical examples of the devastating effects of poor physical training. This chapter further addressed the outdated U.S. Army physical fitness training doctrine available as the sole source for the planning, execution, and conduct of physical training. This thesis seeks to determine whether current Army physical training programs adequately address the physical training needs of U.S. Army forces. Pursuant to this end research will determine if the components of physical fitness, principles of exercise, drills, and exercise programs outlined in current Army doctrine adequately train soldiers and address the physical fitness needs of an Army at war. This research will occur in four phases. A comparison of the resulting data will lead to conclusions through analysis. These conclusions will answer the research question.

The first phase will outline the evaluation criteria against which three separate fitness programs will be evaluated. Phase two will identify and explain the 10 physical movements TRADOC has identified as critical for all initial entry training (IET) personnel. The third phase will provide an overview of the three analyzed programs. This phase will then evaluate their efficiency in training the 10 critical movements identified in phase two in accordance with the criteria outlined in phase one. The final phase will compare and contrast results, draw conclusions and make recommendations if warranted.

The first phase of the research will identify the key requirements to plan, execute, and measure the results of an effective physical training program. These requirements in the form of components, principles, and factors of fitness will provide the evaluation criteria for the three exercise programs being analyzed. These building blocks are found

in the recently replaced sole source document for U.S. Army physical fitness training, FM 21-20. The first key set of components is the Components of Fitness: cardio-respiratory endurance, muscular strength, muscular endurance, flexibility, and body composition. Also key to the development of an effective physical training program are the Principles of Exercise: regularity, progression, balance, variety, specificity, recovery, and overload. Also found in FM 21-20, related to the Principles of Exercise, and crucial to their progressive development are the FITT Factors: frequency, intensity, time, and type. This collection of factors and principles required to develop an effective physical training program will serve as the evaluation criteria for the three individual programs that will be analyzed in the third phase. Two additional criteria are included in this phase to provide an additional level of analysis: feasibility and transportability. Feasibility speaks to the additional costs incurred on the part of the soldier to utilize a particular program. Transportability identifies the level to which the system can travel with the soldier; can it be executed both at home station and on deployment? Whether a program satisfies each specific evaluation criteria will be depicted in this chart:

Table 1. Evaluation Criteria

EVALUATION CRITERIA			
Components of Fitness		**Principles of Exercise**	
cardio-respiratory endurance		regularity	
muscular strength		progression	
muscular endurance		balance	
flexibility		variety	
body composition		specificity	
FITT Factors		recovery	
frequency		**Additional Criteria**	
intensity		feasibility	
time		transportability	
type			

Source: Created by author utilizing Department of the Army, *Physical Fitness Training* (Washington, DC: Government Printing Office, 1998).

In this chart, one of three values will be entered next to the individual evaluation criteria: (+), (0), or (-). A (+) records an above average satisfaction of the evaluation criteria, a (0) depicts an average satisfaction of the criteria, and a (-) denotes a less than average satisfaction or failure to meet the criteria. These values will be determined by objective comparison of the muscle(s) trained in the exercises as well as a subjective comparison of the actual exercises.

The second phase of research will identify and explain the 10 physical movements specified by TRADOC as critical and common to all new soldiers. Published in 2005, the *IET Standardized Physical Training Guide* identifies the 10 movements as: Lifting from the ground, Lifting overhead, Pushing, Pulling/Climbing, Rotation, Jumping and Landing, Lunging, Marching, Running, and Change Direction. Although all 10 functional movements may not be required at all times in all military occupations, TRADOC selected these movements because they collectively represent the best set of physical tasks common to all. The *IET Standardized Physical Training Guide* further defines each move as follows. Lifting from the ground utilizes the legs to power the lift and a bend at the hips and knees to lower the body. Any turning with a load is done by pivoting the feet rather than twisting the trunk. Picking up a rucksack would be an example. Lifting overhead pushes an object overhead by coordinating the efforts of the arms and legs. The majority of the power comes from the legs. Loading a litter casualty into an MRAP would be an example. Pushing places the hands in front of the shoulders and the upper arms close to the body. Pushing a disabled vehicle would be an example. Pulling/Climbing often requires the use of both upper and lower body strength. Assuming the power position is key to beginning this movement to prepare the trunk and pelvic

muscles. Pulling yourself and equipment into a first story window would be an example. Rotation also requires a preparation for the trunk and pelvic muscles. Coiling and then uncoiling the body in a controlled manner generates force. Throwing rations onto the back of a five-ton truck would be an example. Jumping and Landing requires landing on the balls of the feet with the heels hitting last. Bending at the hips and knees also help absorb the shock of landing. Dismounting a rotary wing aircraft would be an example. Lunging maintains the knee of the forward leg in alignment with the lead foot. The forward knee is not allowed to proceed forward of the toes or left or right of the heel. Standing from a kneeling firing position and sprinting to cover would be an example. Marching requires natural arm swing, natural hip rotation forward, placing the foot down heel first and pushing off with the toe, and natural placement of the feet with each stride. A foot march to the military objective would be an example. Running is self explanatory, and changing direction requires planting the outside foot with the toe facing slightly inward to maintain forward momentum. A complete change in direction requires a low crouch with the majority of the weight supported by the leg closest to the new direction of travel. Sprinting to and retrieving a casualty is one example. Establishing this standard list of movements enables detailed identification of the muscles, muscle groups, and complex movements that must be trained regularly to achieve and maintain appropriate combat physicality. A list of the major muscles utilized in each movement is depicted in a chart allowing easy comparison of the exercises utilized in the three analyzed programs. Muscles in bold are the major active muscles in the exercise. Other listed muscles are accessory and deep muscles. Below is an example of the Pulling/Climbing movement. The movement was first evaluated and broken down into its individual movements.

These individual movements were then analyzed utilizing exercise anatomy and physiology texts. The requisite upper and lower body muscles were then recorded to enable comparison to the other training programs:

Table 2. Pulling/Climbing Muscle Utilization

PULLING / CLIMBING			
UPPER BODY		LOWER BODY	
FRONT	BACK	FRONT	BACK
anterior deltoid(S)	coracobrachialis(A)	*adductor longus(TH)	*biceps femoris(TH)
biceps brachi(A)	extensor carpi radials(A)	*gracillis(TH)	*gastrocnemius(LL)
brachialis(A)	**infraspinatus(B)**	*pectineus(H)	*gluteus maximus((H)
brachioradialis(A)	**latissimus dorsi(B)**	*rectus femoris(TH)	*semimembranosus(TH)
extensor carpi radials(A)	levator scapulae (B)	*sartorius(TH)	*semitendinosus(TH)
flexor digitorum(A)	medial deltoid(S)	*tibialis(LL)	*soleus(LL)
serratus anterior(TR)	**posterior deltoid(S)**		
	rhomboid(B)		
	subscapularis(B)		
	teres major(B)		
	teres minor(B)		
	trapezius(S)	*Engaged if leg assisted climbing techniques are utilized	

Source: Created by author utilizing Pat Mannochia, *Anatomy of Exercise* (New York: Firefly Books, 2008), 10-13, 82-83, 88-89.

The third phase of research will provide an overview of the three training programs to be compared: CrossFit, P90X, and the U.S. Army PRT. These three programs will then be compared and analyzed on their ability to train the 10 critical movements identified in phase two utilizing the principles, factors, and components essential to an effective training program as stated in phase one. These principles, factors, and components are the foundational building blocks of successful physical training programs. Although these criteria are derived from the U.S. Army's recently replaced FM 21-20, *Physical Fitness Training*, the training principles they represent are timeless and

are reflected in the new *Army Physical Readiness Training* and most successful alternative programs. Their use as evaluation criteria enables comparison of all three programs by establishing baseline evaluation criteria. This assessment will determine the strengths and weaknesses of each program in training the 10 requisite physical movements as well as the strengths and weaknesses of each program relative to each other.

The final phase of research will compare and contrast the abilities and inabilities of the three programs studied in phase 3. This comparison will provide the level of detail necessary to determine whether the components of physical fitness, principles of exercise, drills, and exercise programs outlined in current Army doctrine adequately train the identified combat movements and address the physical fitness needs of an Army at war. It will determine if the recent changes in U.S. Army physical training doctrine are valid and better address the physical training needs of soldiers. It will also show whether the proposed changes incorporate advances in training techniques and utilize successful methodologies prevalent in successful commercial programs. The results from this phase will ultimately be used to make recommendations if warranted and identify areas of additional interest and study.

CHAPTER 4

ANALYSIS

The current U.S. Army physical training program is in a transitional period. This chapter will determine if that transition is on track and if proposed doctrine will provide the necessary tools for leaders to train soldiers for combat. Many of the fitness principles and foundations outlined in current doctrine are still applicable and are key to the development of a sound training program. What FM 21-20 did not provide was a quick, one-stop resource for leaders to determine key combat tasks to train and specific exercises and exercise plans to address those tasks. The majority of the criteria used to evaluate the three programs in this thesis are derived from the former sole source Army physical fitness doctrine, FM 21-20. TC 3-22.20, *Army Physical Readiness Training,* replaced FM 21-20 on 1 March 2010. While many of the exercises and programs outlined in FM 21-20 were dated and inadequate, the principles, components and factors used to develop training programs remain sound. The majority of these, in fact, are mirrored in many commercially available training programs and publications. Augmenting the criteria from FM 21-20 are two additional criteria, feasibility and transportability. In preparation for and in conjunction with the new doctrine, TRADOC identified the 10 physical movements that all IET soldiers must be able to accomplish. Once these 10 movements have been identified and explained, they will be compared utilizing the aforementioned list of evaluation criteria. With the 10 movements and their evaluation criteria identified, this thesis will then focus on the three training programs being analyzed. Each program will be introduced followed by an in-depth overview of the program, its overall training philosophy and the exercises each employs. These exercises

will be evaluated not only on their ability to fulfill the previously mentioned evaluation criteria, but also on their ability to effectively train the 10 TRADOC movements. Finally, the strengths and weaknesses of each program will be compared to both the criteria and the other programs. This analysis will yield recommendations and possible areas of additional study pertinent to the topic.

Phase 1 Evaluation Criteria

There are several components that are key to the planning, execution and measuring the results of an effective physical training program. Following are short definitions of these components, principles and factors as described in FM 21-20 followed by a brief discussion of why they are important in the construct of a physical fitness program.

Components of Fitness

The first five components mentioned earlier in this thesis are cardio-respiratory endurance, muscular strength, muscular endurance, flexibility, and body composition.

Cardio-respiratory endurance is the efficiency with which the body delivers oxygen and nutrients needed for muscular activity and transports waste products from the cells. Inherent within this definition is the smooth operation and synergy of two separate systems, the circulatory system and pulmonary system. The lungs must operate at peak efficiency to extract the maximum amount of oxygen with each ambient breath. Each breath inflates the individual alveoli, or air sacs, that comprise the bulk of the lungs. Oxygen is then able to diffuse into the circulatory system via the network of blood vessels wrapped around each alveolus. With each heartbeat oxygen-rich blood is pumped

away from the lungs and out to the body to perfuse muscle tissue during exercise. At the same time oxygen-depleted is pumped back toward the lungs to be re-oxygenated. Since the body derives most of its energy from aerobic activity (in the presence of oxygen), any break down or inefficiency in this system results in less than optimal physical performance. The efficient function of the cardio-respiratory system also directly or indirectly affects the other components of fitness.

The second component of fitness, muscular strength, is the greatest amount of force a muscle or muscle group can exert in a single movement. Unique from the other fitness components, muscular strength exercise takes place in a largely anaerobic (without oxygen) environment. The single movement calls for a burst of high output, short duration energy.

The third component, muscular endurance, is the ability of a muscle or group of muscles to perform repeated movements with a sub-maximal force for extended periods of time. As stated earlier, this component is directly affected by cardio-respiratory health. The majority of the body's energy is generated aerobically, so repeated muscular contractions are dependent on an oxygen supply system that can supply those movements. The burn that is felt during the 2-minute push-up event during the Army Physical Fitness Test (APFT) is a good example of the effort exceeding the oxygen supply. As the level of physical exertion increases during exercise, so does the body's appetite for oxygen. Increased respirations to supply that additional oxygen also produce increased blood levels of carbon dioxide, the by-product of respiration. If the lungs are unable to efficiently expel this increased carbon dioxide output, the burn is felt in the muscles and the soldier must go to the rest position until he can "blow off" some of the

excess carbon dioxide and re-oxygenate his blood. The component least affected by cardio-respiratory endurance is flexibility.

Flexibility is the ability to move the joints (elbow, knee, etc.) or any group of joints through an entire, normal range of motion. Flexibility does, though, affect both muscular strength and muscular endurance. The smooth articulation of joints and groups of joints are key to the powerful and efficient contractions of the muscles and muscle groups whose power and energy they direct. The more efficiently a joint is able to move throughout its entire range of motion, the more forcefully the joint can project the power of the muscles that surround it.

The final component, body composition, is the amount of body fat a soldier has in comparison to his total body mass. Physical activity in general has a direct effect on a soldier's body composition. This begins on the cellular level. Muscle cells aerobically break down glycogen, carbohydrates, and fats to produce energy. The more regularly the individual conducts cardio-respiratory training, the more efficiently the body converts these substances to energy instead of storing them as potential energy, or fat. Several other factors also play a part in individual body composition. Genetics, disease, and prolonged injury and a resultant sedentary lifestyle are all examples of factors beyond an individual's control. Effective and regular exercise, diet, and lifestyle choices such as consuming alcohol and smoking or dipping are factors within an individual's control. The key is to maximize the impact of the positive decisions that can be affected while minimizing the affects of those beyond one's control.

Frequency, Intensity, Time, Type Factors

The FITT Factors discussed in this thesis and used as evaluation criteria are frequency, intensity, time, and type. FM 21-20 is fairly prescriptive in what it considers the proper frequency of physical training, "vigorous physical fitness training will be conducted 3 to 5 times per week. For optimal results, commanders must strive to conduct 5 days of physical training per week" (U.S. Department of the Army 1998, 1-4). FM 21-20 goes on to give examples of how to utilize a 5-day training program to focus on cardio-respiratory fitness one week and muscle strength and endurance the next week. These workouts are based on a 5-day workweek and a 60-90 minute physical training session depending on the type of unit conducting the physical training. Intensity is how hard you are working while you are exercising. "Intensity is probably the single most important factor for improving performance" (U.S. Department of the Army 1998, 2-2). To determine the correct intensity for a cardio-respiratory workout, varying percentages of Heart Rate Reserve (HRR), Maximum Heart Rate (MHR), Resting Heart Rate (RHR), and Training Heart Rate (THR) are utilized. The two methods used to determine the correct intensity, or THR, are the Percent MHR Method and the Percent HRR Method. The Percent MHR Method is easier to calculate and the Percent HRR is more accurate. To determine the THR of a 40 year-old male, the soldier would first determine his estimated MHR by subtracting his age from 220. This would give him an estimated MHR of 180. Then to determine a THR that is 80% of his MHR he would multiply his estimated MHR of 180 by .80 giving him a THR of 144 beats per minute (U.S. Department of the Army 1998, 2-3 to 2-5). Key to this method, of course, is the ability to accurately monitor your heart rate during exercise. Time refers to the actual amount of

time spent in exercise. Cardio-respiratory endurance requires a minimum of 20 continuous minutes of activity to achieve a training effect. Muscular strength and endurance time requirements are directly related to the time required to complete the determined amount of repetitions and sets utilizing the proper form. Type refers to what specific training is performed. Closely related to the exercise principle of specificity, this factor draws a direct correlation between the similarity of the exercise performed and the desired training effect, “to improve performance, one must practice the particular exercise, activity, or skill he wants to improve” (U.S. Department of the Army 1998, 1-7).

Principles of Exercise

Equally as important as the different physiological processes trained in a fitness program are the principles that address the actual structure of the program. The principles of exercise: overload, progression, regularity, variety, recovery, balance, and specificity address the different temporal facets of a properly structured physical training program. The principle of overload is not proprietary to Army physical training. Overload is a universal training concept upon which all exercise programs are built. Muscles must be exposed to a workload greater than that which they normally experience. Muscles react to the overload principle by growing, becoming stronger, and achieving greater endurance. Progression is continually challenging those same muscles as they grow and adapt to the increased workload. Historically this progression has manifested itself as 5-10 percent increase in either the weight being moved, or the number or correctly performed repetitions in a set. Alternative programs will also discuss increases in speed as valuable metrics to ensure progression. So how are these muscles overloaded and continually

challenged? FM 21-20 states, “Exercise must be done regularly to produce a training effect” (U.S. Department of the Army 1998, 3-4).

So what does regularly really mean? FM 21-20 goes on to state that three strength workouts a week yield optimal results. There are varying schools of thought on what constitutes regularity in different training regimens. These differences will be addressed in depth during the analysis of the individual training programs. Just as important as how often to train is keeping workouts interesting. Even if all the proper principles, factors and components have been incorporated in a program, soldiers will not stick to the program if it is boring. Different ways of attacking the same muscle groups should be alternated to keep workouts fresh. Also, some of the equipment utilized in garrison will not available on deployment. Developing alternatives to machines and barbells not only adds variety, it also enables soldiers to continue their pursuit of physical excellence in the field. Variety is also key in a technique called undulating periodization or muscle confusion. The Soldier keeps the body guessing and continues to make gains. Proper recovery is also key to increased performance in any training program. Recovery is important on both a macro and micro scale. On the macro scale, adequate time must be allotted so muscles or muscle groups can grow and adapt to the stresses to which they have been exposed Repeated stress of like muscles or muscle groups does not allow enough recovery time to encourage proper growth and adaptation and can, in fact, be detrimental to the desired training effect. FM 21-20 recommends, “at least a 48-hour recovery period between workouts for the same muscle group” (U.S. Department of the Army 1998, 3-5). This is a widely accepted training principle and has given rise to the day on, day off workout schedule that is prevalent across the Army. A typical workout

would utilize lower body workouts on Monday, Wednesday, and Friday and upper body workouts on Tuesday, Thursday, and Saturday. Alternate training programs have adopted differing methods of addressing recovery. These will also be addressed in the detailed analysis of each program. Similarly, allowing the proper recovery time is also important on a micro scale within each workout. In a pull-up workout of three sets of ten repetitions, adequate rest between sets is required to enable maximum effort during each individual set. This recovery time is adjustable dependent upon the desired training effect of the workout. When trying to develop muscular endurance, a shorter rest period between sets would be prudent. Building muscular strength, conversely, would call for a longer rest period. As important as recovery is the principle of balance. FM 21-20 promotes working the naturally occurring opposing muscle pairs in the body. This develops both the pushing and pulling muscles on both sides of paired joints not only leads to better overall strength development, but also reduces exercise related injuries. Most soldiers will adequately target the rectus abdominus and to a lesser degree the transversus abdominus, obliquus internus, obliquus externus (abdominal muscles), iliopsoas (upper inner thigh), and latissimus dorsi (left and right sides of trunk) muscles as they train for the sit-up event in the APFT. What they may fail to properly address are the erector spinae (along the spine), quadratus lumborum (lower back), and gluteus maximus (buttocks) that are the opposing muscles worked during the execution of a back extension. Developing the muscles on both sides of a shared joint further stabilizes that joint and enables increased physical output. The pairs of opposing muscles to train are also very important. In addressing specificity, FM 21-20 advises identifying which performance tasks require improvement. In the conduct of those tasks, the soldier should

note which muscle or groups of muscles are engaged on both sides of the involved joints. Workouts should then target those specific muscles utilizing motions that mimic the execution of the task as closely as possible.

Phase 2 The 10 Physical Movements

TRADOC has identified the 10 physical movements critical for all soldiers: Lifting from the Ground, Lifting Overhead, Pushing, Pulling/Climbing, Rotation, Jumping and Landing, Lunging, Marching, Running, and Change Direction. Although various occupations in the military require vastly different levels of physical strength and endurance, these 10 functional movements collectively represent the best set of physical tasks common to all.

The first movement identified in Training Circular (TC) 3-22.20 Physical Readiness Training (PRT) is lifting from the ground. Below is the written description. See figure 1 for associated images.

> Power the lift with the legs, not the back. Then continue to bend at the hips and knees to lower the body. To protect the back, keep the hips set and the abdominal muscles tight throughout the lift. Keep the load close to the body from start to finish. When Soldiers must turn under load, do so by pivoting the feet rather than twisting the trunk. (U.S. Department of the Army 2010, C-10)

Figure 1. Lifting From the Ground
Source: Department of the Army, *Army Physical Readiness Training* (Washington, DC: Government Printing Office, 2010), C-11.

These words and pictures can be utilized to determine the muscles and muscle groups active during the task lifting from the ground. Since Manocchia's *Anatomy of Exercise* does not specifically address this TRADOC task, the similar mechanics of the dead lift were studied to determine which similar muscles are employed. These results are depicted in table 3. In order to facilitate easier analysis of the fitness programs in the next section, body segments trained in these fitness programs are included following the definitive muscle identifications. These general classifications will be: hips (H), thighs (TH), lower legs (LL), chest (C), back (B), trunk (TR), shoulders (S), and arms (A). Additionally, major muscles trained will be in bold type. Other listed muscles are accessory muscles and deep muscles also necessary to perform the movement.

Table 3. Lifting From the Ground Muscle Utilization

Lifting from the Ground			
UPPER BODY		LOWER BODY	
FRONT	BACK	FRONT	BACK
biceps brachi(A)	erector spinae(B)	adductor longus(H)	biceps femorus(TH)
brachialis(A)	infraspinatus(B)	adductor magnus(TH)	gastrocnemius(LL)
extensor digitorum(A)	levator scapulae(B)	extensor digitorum(A)	gluteus maximus(H)
flexor digitorum(A)	posterior deltoid(S)	gracilis(TH)	semimembranosus(TH)
medial deltoid(S)	quadratus lumborum(B)	pectineus(H)	semitendinosus(TH)
obliquus externus(TR)	rhomboid(B)	rectus femoris(TH)	soleus(LL)
obliquus internus(TR)	teres major(B)	sartorius(TH)	
pectoralis major(C)	trapezius(S)	semimembranosus(TH)	
rectus abdominus(TR)	triceps brachi(A)	semitaninosis(TH)	
		tensor fascia latae(H)	
		tibialis anterior(LL)	
		vastis lateralis(TH)	
		vastis medialis(TH)	

Source: Created by author utilizing Pat Mannochia, *Anatomy of Exercise* (New York: Firefly Books, 2008), 80-81.

This and those to follow depict the majority of the active muscles, stabilizing muscles, and deep muscles utilized in the annotated tasks. They do not, however depict every single accessory muscle required to complete the task. These tables also do not account for the variations in grips or hand and foot positions that could affect which muscles are active and static. They do provide a basis of comparison by which the three analyzed fitness programs can be compared and contrasted.

The next task identified in the acclaimed *Army Physical Readiness Training* (APRT) is lifting overhead. “According to Artie Drechsler, the author of the acclaimed

The Weightlifting Encyclopedia, shoulder injuries were rare when the press was a contested exercise . . . a much higher volume of pressing was practiced" (Staley and Snideman 2010). Since the overhead press has fallen out of favor, the press is practiced less often and injuries have increased. Proper lifting technique and adequate strength enable Soldiers to safely perform numerous tasks that involve moving weight overhead. A corresponding picture follows the written description for the overhead press from the APRT (see figure 2).

> Most of the power for pushing an object overhead comes from the legs. To transmit leg strength through the trunk and arms to the object being pushed, set the hips and tighten the abdominal muscles. Hands should be placed shoulder width apart with the upper arms in line with the trunk. Squat slightly, then forcefully straighten the legs in a coordinated effort with the action of the arms. (U.S. Department of the Army, 2010, C-10)

Figure 2. Lifting Overhead
Source: Department of the Army, *Army Physical Readiness Training* (Washington, DC: Government Printing Office, 2010), C-11.

Table 4. Lifting Overhead Muscle Utilization

Lifting Overhead			
UPPER BODY		LOWER BODY	
FRONT	BACK	FRONT	BACK
anterior deltoid(S)	erector spinae(B)	adductor longus(H)	biceps femorus(TH)
biceps brachi(A)	extensor carpi radialis(A)	adductor magnus(TH)	gastrocnemius(LL)
brachialis(A)	infraspinatus(B)	extensor digitorum(A)	gluteus maximus(H)
brachioradialis(A)	latissimus dorsi(B)	gracilis(TH)	soleus(LL)
flexor carpi radialis(A)	levator scapulae(B)	pectineus(H)	semimembranosus(TH)
flexor digitorum(A)	posterior deltoid(S)	rectus femoris(TH)	semitendinosus(TH)
medial deltoid(S)	quadratus lumborum(B)	sartorius(TH)	
obliquus externus(TR)	rhomboid(B)	semimembranosus(TH)	
obliquus internus(TR)	splenius(S)	semitaninosis(TH)	
pectoralis major(C)	supraspinatus(B)	tensor fascia latae(H)	
pectoralis minor(C)	teres major(B)	tibialis anterior(LL)	
scalenes(C)	teres minor(B)	vastis lateralis(TH)	
serratus anterior(TR)	trapezius(S)	vastis medialis(TH)	
sternocleidomastoid(S)	triceps brachi(A)		
transversus abdominus(TR)			

Source: Created by author utilizing Pat Mannochia, *Anatomy of Exercise* (New York: Firefly Books, 2008), 80-81, 126-127.

Pushing is the next task mentioned in TC 3-22.20. Improper pushing technique can cause or exacerbate both shoulder and lower back injuries. The Occupational Safety and Health Administration (OSHA) addressed these injuries specifically in its 2000 publication of *Ergonomics: The Study of Work*. Hand placement above the shoulders or below the waist also increases the chance for injury. A corresponding picture follows the written description (see figure 3).

> Push with the hands in front of the shoulders and the upper arms close to the body. This technique creates a mechanical advantage that is lost the farther the hands and arms are from this position. Because this method is the most functional, push ups performed in the conditioning drills use this technique. (U.S. Department of the Army, 2010, C-12)

Figure 3. Pushing

Source: Department of the Army, *Army Physical Readiness Training* (Washington, DC: Government Printing Office, 2010), C-12.

Table 5. Pushing Muscle Utilization

Pushing			
UPPER BODY		LOWER BODY	
FRONT	BACK	FRONT	BACK
anterior deltoid(S)	erector spinae(B)	adductor magnus(TH)	biceps femorus(TH)
coracobrachialis(C)	latissimus dorsi(B)	extensor digitorum(LL)	gastrocnemius(LL)
pectoralis major(C)	medial deltoid(S)	extensor hallucis(LL)	gluteus maximus(H)
pectoralis minor(C)	obliquus externus(TR)	iliopsoas(TH)	peroneus(LL)
serratus anterior(TR)	quadratus lumborum(TR)	rectus femoris(TH)	soleus(LL)
rectus abdominus(TR)	triceps brachi(A)	sartorius(TH)	semimembranosus(TH)
transversus abdominus(TR)		tensor fasciae latae(TH)	semitendinosus(TH)
		tibialis anterior(LL)	
		vastus intermedius(TH)	
		vastus lateralis(TH)	
		vastus medialis(TH)	
		adductor longus(TH)	
		gracilis(TH)	

Source: Created by author utilizing Pat Mannochia, *Anatomy of Exercise* (New York: Firefly Books, 2008), 40-41, 44-45, 100-101.

The *APRT* identifies Pulling/Climbing as the next critical task. Soldiers must be able to negotiate both the courtyard mazes in Iraq and mud walls in Afghanistan. Illustrations follow the written description of Pulling/Climbing (see figure 4).

> When pulling an object that is on the ground or horizontal to it, Soldiers must first assume the power position. Set the shoulder girdle by pulling the shoulder blades slightly to the rear. This is also important when pulling the body upward from an overhead grasp. Climbing will often require the legs to power the accent or gain leverage on support structures (figure C-15). This will demand significant strength from the trunk muscles. The exercises in the climbing drills prepare Soldiers for these demands. (U.S. Department of the Army, 2010, C-12)

Figure 4. Pulling/Climbing
Source: Department of the Army, *Army Physical Readiness Training* (Washington, DC: Government Printing Office, 2010), C-12.

Table 6. Pulling/Climbing Muscle Utilization

Pulling / Climbing			
UPPER BODY		LOWER BODY	
FRONT	BACK	FRONT	BACK
anterior deltoid(S)	coracobrachialis(A)	*adductor longus(TH)	*biceps femoris(TH)
biceps brachi(A)	extensor carpi radials(A)	*gracillis(TH)	*gastrocnemius(LL)
brachialis(A)	infraspinatus(B)	*pectineus(H)	*gluteus maximus((H)
brachioradialis(A)	latissimus dorsi(B)	*rectus femoris(TH)	*semimembranosus(TH)
extensor carpi radials(A)	levator scapulae (B)	*sartorius(TH)	*semitendinosus(TH)
flexor digitorum(A)	medial deltoid(S)	*tibialis(LL)	*soleus(LL)
serratus anterior(TR)	posterior deltoid(S)		
	rhomboid(B)		
	subscapularis(B)		
	teres major(B)		
	teres minor(B)		
	trapezius(S)	*Engaged if leg assisted climbing techniques are utilized	

Source: Created by author utilizing Pat Mannochia, *Anatomy of Exercise* (New York: Firefly Books, 2008), 10-13, 82-83, 88-89.

Rotation is the next task mentioned in APRT. This task involves generating power from the trunk or core of the body. This power generation and the stabilization that the core provides for most other physical movements are critical for overall physical performance. Spondylolysis, a stress fracture to the lower back (Wowbodybuilding.com 2010), and lumbar disc injuries are all too common and debilitating for combat troops. Proper form is key. Representative photos again follow a detailed description (see figure 5).

> Prepare the body's trunk to control rotation. Coiling (rotating) the body, then quickly uncoiling is the primary source of power for many Soldier and athletic tasks such as throwing a punch or heaving an object onto a platform (figure C-16). Each of these activities produces a torque on the spine and other joints that may cause injury if the forces are uncontrolled. Control comes from setting the hips, tightening the abdominals and allowing the hips and knees to bend so as to absorb some of the stress of rotation. (U.S. Department of the Army, 2010, C-13)

Figure 5. Rotation
Source: Department of the Army, *Army Physical Readiness Training* (Washington, DC: Government Printing Office, 2010), C-13.

Table 7. Rotation Muscle Utilization

Rotation			
UPPER BODY		LOWER BODY	
FRONT	BACK	FRONT	BACK
anterior deltoid(S)	erector spinae(B)	adductor longus(TH)	adductor magnus(TH)
biceps brachi(A)	extensor digitorum(A)	extensor hallucis(LL)	biceps femoris(TH)
flexor digitorum(A)	infraspinatus(B)	gracilis(TH)	flexor hallucis(LL)
medial deltoid(S)	latissimus dorsi(B)	pectineus(TH)	gastrocnemius(LL)
obliquus externus(TR)	posterior deltoid(S)	peroneus(LL)	gluteus maximus(H)
obliquus internus(TR)	quadratus lumborum(TR)	rectus femoris(TH)	gluteus medius(H)
rectus abdominus(TR)	subscapularis(B)	sartorius(TH)	piriformis(H)
transversus abdominus(TR)	teres major(B)	tibialis anterior(LL)	semimembranosus(TH)
	teres minor(B)	vastus intermedius(TH)	semitendinosus(TH)
	trapezius(S)	vastus lateralis(TH)	soleus(LL)
	triceps brachi(A)	vastus medialis(TH)	tibialis posterior(LL)

Source: Created by author utilizing Pat Mannochia, *Anatomy of Exercise* (New York: Firefly Books, 2008), 38-39, 181-182.

Whether rapidly dismounting MRAPs and cargo trucks, or jumping across irrigation ditches, jumping and landing require proper technique. With an average combat

load of 75-100 pounds (Danny 2010), Soldiers must pay attention as they maneuver with this additional weight. The APRT next describes Jumping and Landing followed by its illustration (see figure 6).

> Land softly with alignment of the shoulders, knees and balls of the feet. Land first on the balls of the feet with the heels touching down last. Bending of the hips and knees allows the legs to serve as coils that absorb the impact of the landing. The trunk should be straight but leaning forward so when it is viewed from the side, the shoulders, knees and balls of the feet are aligned. (U.S. Department of the Army, 2010, C-13)

Figure 6. Jumping and Landing
Source: Department of the Army, *Army Physical Readiness Training* (Washington, DC: Government Printing Office, 2010), C-13.

Table 8. Jumping and Landing Muscle Utilization

Jumping and Landing			
UPPER BODY		LOWER BODY	
FRONT	BACK	FRONT	BACK
anterior deltoid(S)	erector spinae(B)	adductor longus(TH)	adductor magnus(TH)
biceps brachi(A)	latissimus dorsi(B)	gracilis(TH)	biceps femoris(TH)
obliquus externus(TR)	quadratus lumborum(H)	iliacus(TH)	gastrocnemius(LL)
obliquus internus(TR)	rhomboid(B)	iliopsoas(TH)	gluteus maximus(H)
rectus abdominus(TR)		pectineus(TH)	semimembranosus(TH)
transverse abdominus(TR)		rectus femoris(TH)	semitendinosus(TH)
		sartorius(TH)	soleus(LL)
		tensor fasciae latae(TH)	
		vastus intermedius(TH)	
		vastus lateralis(TH)	
		vastus medialis(TH)	

Source: Created by author utilizing Pat Mannochia, *Anatomy of Exercise* (New York: Firefly Books, 2008), 44-47.

Lunging is covered next in the APRT. This task utilizes the main muscles in both the upper and lower leg. In urban terrain lunging is key to transitioning from a prone position up to the feet to begin running. In mountainous terrain, it is absolutely critical in ascending steep grades while under load (see figure 7).

> Maintain the knee of the forward leg in vertical alignment with the ball of the foot. Do not allow the knee to go beyond the toes or to the right or left of the foot. Lunging is a component of many Soldier tasks. . . . Conditioning and kettle bell exercises that involve squatting lunging prepare Soldiers for functional tasks such as this. (U.S. Department of the Army, 2010, C-13)

Figure 7. Lunging
Source: Department of the Army, *Army Physical Readiness Training* (Washington, DC: Government Printing Office, 2010), C-14.

Table 9. Lunging Muscle Utilization

Lunging			
UPPER BODY		LOWER BODY	
FRONT	BACK	FRONT	BACK
obliquus externus(TR)	erector spinae(B)	extensor digitorum(LL)	adductor magnus(TH)
transversus abdominus(TR)	quadratus lumborum(TR)	extensor hallucis(LL)	biceps femoris(TH)
		iliopsoas(TH)	gluteus maximus(H)
		peroneus(LL)	
		rectus femorus(TH)	
		soleus(LL)	
		tibialis anterior(LL)	
		vastus intermedius(TH)	
		vastus lateralis(TH)	
		vastus medialis(TH)	

Source: Created by author utilizing Pat Mannochia, *Anatomy of Exercise* (New York: Firefly Books, 2008), 40-41.

Marching is the next task identified in the APRT and has historically been the bread and butter of light dismounted forces. As additional branches and Mission Operational Specialties (MOS) find themselves performing roles historically reserved to

the Infantry, this task is becoming critical for the U.S. Army as a whole. Marching is especially indispensible in the remote areas of Afghanistan where vehicle use is not only problematic, but also impossible (see figure 8).

> The head and trunk checkpoints for standing also apply to marching. Allow the arms to swing naturally, though crossing the midline of the body is excessive. Allow the hips to naturally rotate forward with each stride. Do not allow the knees to lock at any point in the walking cycle. Stride naturally, landing on the heel and pushing off with most of the weight toward the big toe. The feet remain directed forward. Do not strain to keep the feet directed forward, since variations in skeletal alignment will prevent some Soldiers from assuming the feet-forward position. Foot marching with a load on the back will require some forward lean of the trunk. Do not, however, allow the trunk and shoulders to round forward (U.S. Department of the Army, 2010, C-13)

Figure 8. Marching
Source: Department of the Army, *Army Physical Readiness Training* (Washington, DC: Government Printing Office, 2010), C-14.

Table 10. Marching Muscle Utilization

Marching			
UPPER BODY		LOWER BODY	
FRONT	BACK	FRONT	BACK
	erector spinae(B)	adductor hallucis(LL)	adductor digiti quinti pedis(LL)
	infraspinatus(B)	adductor longus(TH)	adductor magnus(TH)
	latissimus dorsi(B)	extensor digitorum(LL)	biceps femoris(TH)
	quadratus lumborum(H)	extensor hallucis(LL)	flexor digitorum(LL)
	subscapularis(B)	gracilis(TH)	flexor hallucis(LL)
	teres major(B)	iliacus(TH)	gastrocnemius(LL)
	teres minor(B)	iliopsoas(TH)	gluteus maximus(H)
	trapezius(S)	pectineus(TH)	gluteus medius(H)
		peroneus(LL)	soleus(LL)
		rectus femoris(TH)	tibialis posterior(LL)
		sartorius(TH)	trochlea tali(LL)
		tensor fasciae latae(TH)	
		tibialis anterior(LL)	
		vastus intermedius(TH)	
		vastus lateralis(TH)	
		vastus medialis(TH)	

Source: Created by author utilizing Pat Mannochia, *Anatomy of Exercise* (New York: Firefly Books, 2008), 10-13, 36-37.

Running is the next task described in the APRT. Although the U.S. Army is re-tooling its approach to running, the number of miles covered weekly, and its relationship to other forms of aerobic endurance training, running remains a mainstay of the Army physical training program. The Army seems to have taken its cue from a United States Marine Corps (USMC) study that showed a 54 percent reduction of stress fractures in USMC recruits by reducing running mileage by 60 percent. This mileage decrease resulted in no significant statistical change in the standard 3 mile run time and saved an estimated $4.5 million in medical costs and 15,000 training days annually (USACHPPM 2010). Below is the Running task description and illustration (see figure 9)

> The purpose of running is to improve the overall conditioning of the Soldier by developing endurance. Endurance spans a continuum between aerobic and anaerobic systems. Aerobic endurance is developed by performing low to moderate intensity activities for a long duration. Anaerobic endurance is

developed by performing high-intensity activities for a short duration, resting and then repeating the sequence. (U.S. Department of the Army, 2010, 10-1)

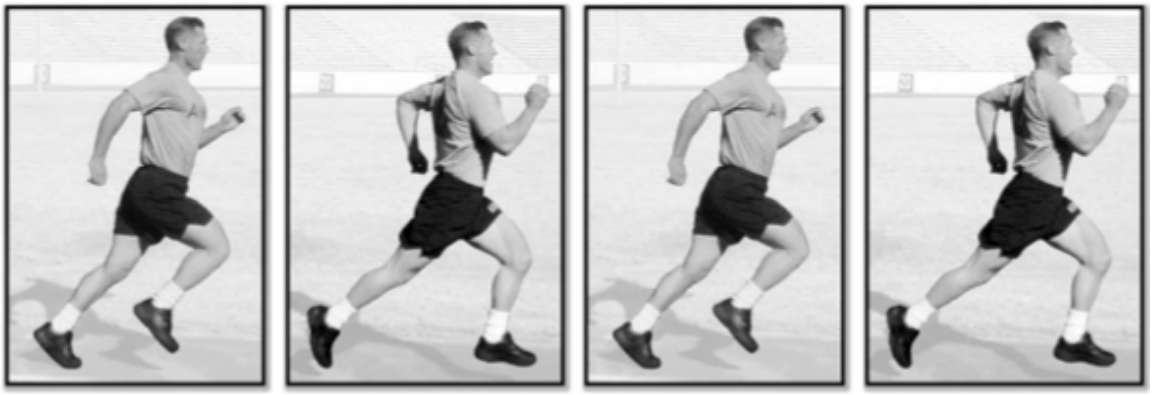

Figure 9. Running

Source: Department of the Army, *Army Physical Readiness Training* (Washington, DC: Government Printing Office, 2010), 10-5.

Table 11. Running Muscle Utilization

Running			
UPPER BODY		LOWER BODY	
FRONT	BACK	FRONT	BACK
biceps brachi(A)	erector spinae(B)	adductor hallucis(LL)	adductor digiti quinti pedis(LL)
obliquus externus(TR)	quadratus lumborum(H)	adductor longus(TH)	adductor magnus(TH)
obliquus internus(TR)		extensor digitorum(LL)	biceps femoris(TH)
rectus abdominus(TR)		extensor hallucis(LL)	flexor digitorum(LL)
transverse abdominus(TR)		gracilis(TH)	flexor hallucis(LL)
		iliacus(TH)	gastrocnemius(LL)
		iliopsoas(TH)	gluteus maximus(H)
		pectineus(TH)	iliotibial band(TH)
		peroneus(LL)	quadratus femoris(TH)
		rectus femoris(TH)	soleus(LL)
		sartorius(TH)	tibialis posterior(LL)
		tensor fasciae latae(TH)	trochlea tali(LL)
		tibialis anterior(LL)	
		vastus lateralis(TH)	
		vastus medialis(TH)	

Source: Created by author utilizing Pat Mannochia, *Anatomy of Exercise* (New York: Firefly Books, 2008), 10-13.

The final task discussed in APRT is Changing Direction. This task enables the Soldier to rapidly change direction without losing excessive forward momentum or completely reverse direction rapidly. The USMC has also identified the importance of changing direction and tests it during the Maneuver Under Fire event of the new USMC Combat Fitness Test (CFT) as outlined in Marine Corps Order 6100.13 (U.S. Department of the Navy 2009). This task is illustrated in figure 10.

> Soldiers may be required to quickly change direction, while maintaining forward movement or to quickly reverse direction. To maintain forward movement, plant on the outside leg with plenty of bend in the hips and knees. The foot should turn slightly inward toward the change of direction. To reverse direction, as in the shuttle run, reduce forward speed and crouch so the body is directed approximately 180 degrees from the forward direction. At the lowest point of the crouch, body weight should rest primarily on the leg closest to the new direction of travel, shifting momentum in that direction. (U.S. Department of the Army, 2010, C-14)

Figure 10. Changing Direction
Source: Department of the Army, *Army Physical Readiness Training* (Washington, DC: Government Printing Office, 2010), C-15.

Table 12. Changing Direction Muscle Utilization

Changing Direction			
UPPER BODY		LOWER BODY	
FRONT	BACK	FRONT	BACK
obliquus externus(TR)	erector spinae(TR)	adductor longus(TH)	biceps femoris(TH)
transversus abdominus(TR)	latissimus dorsi(B)	extensor digitorum(LL)	gastrocnemius(LL)
	quadratus lumborum(TR)	peroneus(LL)	gluteus maximus(H)
	rhomboid(B)	rectus femoris(TH)	gluteus medius(H)
	trapezius(S)	sartorius(TH)	tibialis anterior(LL)
		tensor fasciae latae(TH)	
		vastus lateralis(TH)	

Source: Created by author Pat Mannochia, *Anatomy of Exercise* (New York: Firefly Books, 2008), 42-43.

Phase 3 Analysis

This phase will compare the CrossFit, P90X and U.S. Army PRT programs. Charts similar to those depicting the muscles required to complete the 10 critical movements will break down specific exercises or groups of exercises within each program. This will enable an analysis of how well each program is able to train the same or very similar movements utilized to execute the 10 critical tasks. Each program will also be analyzed on its ability to satisfy the additional evaluation criteria outlined in phase 1. This analysis will result in a numeric value. A higher value is more desirable and will provide and additional metric for a side-by-side comparison of the three programs.

CrossFit

As its stated goal, CrossFit seeks a different end state than most fitness programs. Rather than focusing on improving performance in a specific discipline, CrossFit strives to enable its practitioners to be jacks-of-all-trades and masters of none. CrossFit does this by optimizing physical competence in each of ten recognized fitness domains. They are

Cardiovascular and Respiratory endurance, Stamina, Strength, Flexibility, Power, Speed, Coordination, Agility, Balance, and Accuracy" (Glassman 2009b). FM 21-20 addresses five of these same domains in its components of fitness. CrossFit also addresses the Frequency, Intensity, Time, and Type (FITT) principles and the principles of exercise: Regularity, Progression, Balance, Variety, and Recovery. Notably absent is the principle of Specificity. As stated earlier, CrossFit promotes a holistic view of fitness that lends itself to improved general athletic ability rather than excelling in one or two disciplines to the detriment of others. Instead of concentrating on specific body parts, CrossFit groups its exercises into challenging circuits that constantly tax the body with little or no rest, similar to combat. While increasing the weight moved and the number of repetitions completed are still metrics of performance and improvement, time standards are also incorporated pushing the trainee to decrease rest periods and increase muscular endurance as well as muscular strength. CrossFit also places a premium on eating well and identifies nutrition as the base for any true training program. Where CrossFit differs with FM 21-20 is how it maximizes results utilizing not only its ten components, but also its defining themes. The four defining themes of CrossFit are Neuroendocrine Adaptation, Power, Cross-Training, and Functional Movements. Neuroendocrine adaption is the increased release of key hormones and neurological changes in response to heavy resistance exercise (HRE). Power, as defined in chapter one, is the product of strength and speed. CrossFit seeks to increase power daily. Put simply, completing a workout faster and to an increasingly difficult standard is better. Cross Training speaks to the very essence of CrossFit's pursuit of broad based fitness utilizing methodologies ranging from yoga and gymnastics to weight lifting and rowing. Functional movements

replace the isolation movements predominant in typical gym workouts. Instead of lat pull-downs, CrossFit utilizes several variations of palm facing chin-ups. Rather than military press, CrossFit utilizes handstand push-ups. These functional movements are safer because they employ ranges of motion in which joint and muscular pairings naturally function. This facilitates power generation and a more rapid neuroendocrine adaptation. The CrossFit program addresses all the principles outlined in FM 21-20, while paralleling many of the new principles in the Army's new doctrine, TC 3-22.20.

Four CrossFit exercises were chosen from the hundreds available in the exercises and demos section of www.crossfit.com: Weighted Lunge/Weighted Pull-up, Nancy, Fight Gone Bad, and Side Wallball Toss/Shuttle Run. A brief description of each is followed by its muscle utilization analysis.

Weighted lunge/weighted pull-up is performed using a 25 pound dumbbell. During the lunge one 25 pound dumbbell is held in each hand with the arms extended at the sides. The trainee performs 10 lunge steps touching the rear knee to the ground with each step. The trainee then performs 10 pull-ups holding a 25 pound dumbbell between his feet. A set consists of 10 lunge steps and 10 pull-ups. The trainee performs as many sets as possible in 20 minutes. The Weighted Lunge/Weighted Pull-up exercise trains similar movements to both Lunging and Pulling/Climbing of the TRADOC 10 functional movements.

Table 13. Weighted Lunge/Weighted Pull-up Muscle Utilization

Weighted Lunge/Weighted Pull-Up			
UPPER BODY		LOWER BODY	
FRONT	BACK	FRONT	BACK
anterior deltoid (S)	brachialis (A)	extensor digitorum(LL)	adductor magnus(TH)
biceps brachi(A)	brachioradialis (A)	extensor hallucis(LL)	biceps femoris(TH)
flexor carpi radialis (A)	erector spinae (B)	iliopsoas(TH)	gluteus maximus(H)
flexor digitorum (A)	extensor digitorum (A)	peroneus(LL)	
obliquus externus(TR)	infraspinatus (B)	rectus femorus(TH)	
obliquus externus (T)	latissimus dorsi (B)	soleus(LL)	
transversus abdominus(TR)	levator scapulae (B)	tibialis anterior(LL)	
	medial deltoid (S)	vastus intermedius(TH)	
	posterior deltoid (S)	vastus lateralis(TH)	
	quadratus lumborum (TR)	vastus medialis(TH)	
	rhomboid (B)		
	teres major (B)		
	teres minor (B)		
	trapezius(S)		

Source: Created by author utilizing Pat Mannochia, *Anatomy of Exercise* (New York: Firefly Books, 2008), 40-41, 88-89; www.crossfit.com (accessed 29 October 2009).

The next exercise is Nancy, one of the named Workouts Of the Day (WOD) updated daily on the CrossFit website. Nancy consists of a 400m run followed immediately by 15 repetitions of overhead squats with 95 pounds This constitutes one set. A full Nancy workout is comprised of 5 sets in the quickest time possible. The 400m run is self-explanatory. The overhead squat utilizes the same lower body mechanics as both the front and rear squats. The main difference from these exercises occurs in the upper body. In the overhead squat the weight is held above the head with the arms locked out. This position is maintained as the body is lowered until the upper thigh is parallel to the ground, just as in the front and rear squat. Nancy trains similar movements to Lifting From the Ground, Marching, and Running of the TRADOC 10 functional movements.

Table 14. Nancy Muscle Utilization

Nancy			
UPPER BODY		LOWER BODY	
FRONT	BACK	FRONT	BACK
anterior deltoid (S)	brachialis(A)	adductor hallucis(LL)	adductor digiti quinti pedis(LL)
biceps brachi(A)	erector spinae(B)	adductor longus(TH)	adductor magnus(TH)
coracobrachialis (A)	flexor carpi radialis(A)	extensor digitorum(LL)	adductor magnus(TH)
extensor digitorum(A)	flexor digitorum(A)	extensor hallucis(LL)	biceps femoris(TH)
medial deltoid (S)	infraspinatus(B)	gracilis(TH)	flexor hallucis(LL)
obliquus externus (TR)	latissimus dorsi(B)	iliacus(TH)	gastrocnemius(LL)
obliquus internus(TR)	levator scapulae(B)	iliopsoas(TH)	gluteus maximus(H)
pectoralis major (C)	posterior deltoid (S)	pectineus(TH)	gluteus medius(H)
pectoralis minor (C)	quadratus lumborum(H)	peroneus(LL)	quadratus femoris(TH)
rectus abdominus(TR)	rhomboid(B)	rectus femoris(TH)	semimembranosus(TH)
scalenes(C)	subscapularis(B)	sartorius(TH)	semitendinosus(TH)
serratus anterior (TR)	supraspinatus(B)	tensor fasciae latae(TH)	soleus(LL)
splenius(S)	teres major(B)	tibialis anterior(LL)	tibialis posterior(LL)
sternocleidomastoid(S)	teres minor(B)	tibialis anterior(LL)	trochlea tali(LL)
transversus abdominus (TR)	trapezius(S)	vastus intermedius (TH)	
	triceps brachi(A)	vastus lateralis(TH)	
		vastus medialis(TH)	

Source: Created by author utilizing Pat Mannochia, *Anatomy of Exercise* (New York: Firefly Books, 2008), 36-39, 80-81,126-127; www.crossfit.com (accessed 29 October 2009).

Fight Gone Bad is another of the named WODs. Fight Gone Bad consists of 1 minute each of 5 separate exercises followed by a 1-minute rest. This circuit is completed 3 times. The first exercise is rowing on the Concept 2 rowing machine. One point is scored for each calorie burned. The next event is the wallball toss. In this event men use a 20pound medicine ball and women use a 14 pound medicine ball. The exercise begins with the ball held at the chest level. The trainee then lowers their body like they are conducting a squat. As the trainee executes the second portion of the squat and returns to

the standing position, he pushes the medicine ball upward to hit a target line or spot 10 feet up on the wall. As the medicine ball descends, the trainee absorbs its impact with bent arms, returns the medicine ball to the chest level, and continues to perform a second squat. This rhythm continues and one point is awarded for each correctly performed wallball toss.

The next event is the Sumo Deadlift/High Pull Ground to Chin. In this event men use a 75 pound bar and women use a 53 pound bar. The trainee utilizes a close grip and performs a deadlift. Instead of stopping with the weight at the waist, however, he continues to lift weight bringing the bar to the chin level. The weight is then lowered back to the waist level and, finally, to the ground. A point is awarded for each correctly performed repetition. The Pushpress is the next event. Similar to the previous event, men use a 75 pound bar and women use a 53 pound bar. The trainee begins the pushpress in the standing position with the bar held at the chest level. Generating power with the legs, he then pushes the weight overhead and locking out the arms. He then returns the weight to chest level to complete the repetition. One point is awarded for each correctly performed repetition. The final event of Fight Gone Bad is the box jump. Utilizing a 24-inch wooden box, the trainee jumps with both feet landing on top of the box and then jumps back to the ground. One point is awarded for each repetition. Fight Gone Bad was originally designed to simulate the intense physical challenge of a Mixed Martial Arts (MMA) fight. A normal MMA bout consists of 3 5-minute rounds. After completing the workout, BJ Penn, Ultimate Fighting Championship (UFC) champ commented that it felt, “like a fight gone bad.” (Glassman 2009d) The name stuck. Fight Gone Bad trains similar

movements to Lifting from the Ground, Lifting Overhead, Pushing, Pulling/Climbing, Jumping and Landing, and Lunging of the TRADOC 10 functional movements.

Table 15. Fight Gone Bad Muscle Utilization

Fight Gone Bad			
UPPER BODY		LOWER BODY	
FRONT	BACK	FRONT	BACK
anterior deltoid(S)	brachialis(A)	adductor longus(TH)	adductor magnus(TH)
biceps brachi(A)	brachioradialis(A)	iliacus(TH)	biceps femoris(TH)
coracobrachialis(C)	extensor carpi radialis(A)	iliopsoas(TH)	gastrocnemius(LL)
flexor carpi radialis(A)	erector spinae(B)	pectineus(TH)	gluteus maximus(H)
flexor digitorum(A)	extensor carpi radialis(A)	rectus femoris(TH)	quadratus femoris(TH)
medial deltoid(S)	extensor digitorum(A)	sartorius(TH)	semimembranosus(TH)
obliquus externus(TR)	infraspinatus(B)	tensor fasciae latae(TH)	semitendinosus(TH)
obliquus internus(TR)	latissimus dorsi(B)	tibialis anterior(LL)	vastus lateralis(TH)
pectoralis major(C)	levator scapulae(B)	vastus intermedius(TH)	soleus(LL)
pectoralis minor(C)	posterior deltoid(S)	vastus lateralis(TH)	
rectus abdominus(TR)	quadratus lumborum(H)	vastus medialis(TH)	
scalenes(C)	rhomboid(B)	gracilis(TH)	
serratus anterior(TR)	subscapularis(B)		
splenius(S)	supraspinatus(B)		
sternocleidomastoid(S)	teres major(B)		
transverse abdominus(TR)	teres minor(B)		
	trapezius(S)		
	triceps brachi(A)		

Source: Created by author utilizing Pat Mannochia, *Anatomy of Exercise* (New York: Firefly Books, 2008), 44-47, 82-83, 88-89, 100-101, 126-127; www.crossfit.com (accessed 29 October 2009).

The fourth exercise cited is the Side Wallball Toss/Shuttle Run. For the first portion of the event the trainee stands approximately 5 feet from the wall with his left shoulder facing the wall. Holding the medicine ball at waist level he then rotates his

upper body, throws the medicine ball at a target area approximately shoulder high, and then catches the medicine ball. He completes 10 repetitions throwing to his left followed by 10 repetitions throwing to his right. The second portion of the event is a shuttle run to 5, 10, 15, and 20 meters in succession returning to the start point after each 5-meter increment. At each distance the trainee's foot must touch the line as he lowers his body, reverses his direction, and returns to the start line. Ten side Wallball tosses to both the left and right and one full shuttle run is one set. Five full sets completed in the shortest amount of time complete the exercise. The Side Wallball Toss/Shuttle Run trains movements similar to Rotation, Running, and Changing Direction of the TRADOC 10 functional movements.

Table 16. Side Wallball Toss/Shuttle Run Muscle Utilization

Side Wallball Toss/Shuttle Run			
UPPER BODY		LOWER BODY	
FRONT	BACK	FRONT	BACK
anterior deltoid(S)	rhomboid(B)	vastus lateralis(TH)	adductor magnus(TH)
biceps brachi(A)	erector spinae(B)	adductor longus(TH)	biceps femoris(TH)
flexor digitorum(A)	extensor digitorum(A)	extensor digitorum(LL)	flexor hallucis(LL)
medial deltoid(S)	infraspinatus(B)	extensor hallucis(LL)	gastrocnemius(LL)
obliquus externus(TR)	latissimus dorsi(B)	gracilis(TH)	gluteus maximus(H)
obliquus internus(TR)	posterior deltoid(S)	peroneus(LL)	gluteus medius(H)
pectineus(TR)	quadratus lumborum(TR)	rectus femoris(TH)	piriformis(H)
rectus abdominus(TR)	subscapularis(B)	sartorius(TH)	semimembranosus(TH)
transversus abdominus(TR)	teres major(B)	vastus intermedius(TH)	semitendinosus(TH)
	triceps brachi(A)	tensor fascia latae (TH)	soleus(LL)
	teres minor(B)	tibialis anterior(LL)	tibialis posterior(LL)
	trapezius(S)	vastus medialis(TH)	

Source: Created by author utilizing Pat Mannochia, *Anatomy of Exercise* (New York: Firefly Books, 2008), 38-39, 42-43, 180-181; www.crossfit.com (accessed 29 October 2009).

Components of Fitness

Cardio-respiratory endurance, muscular strength, muscular endurance, and flexibility directly correlate to 4 of the 10 CrossFit 10 recognized fitness domains: cardio and respiratory endurance, strength, endurance and flexibility. CrossFit also specifically addresses body composition with its focus on nutrition as a foundation of physical training. CrossFit maintains that your diet should include: proteins as 30 percent of total caloric intake, predominantly low-glycemic carbohydrates about 40 percent, and fats, predominantly monosaturated, about 30 percent. “In plain language, base your diet on garden vegetables, especially greens, lean meats, nuts and seeds, little starch, and no sugar”(Glassman 2009b).

Frequency, Intensity, Time, and Type Factors

The frequency of CrossFit workouts falls well within the 3-5 workouts per week outlined in FM 21-20. CrossFit utilizes a cycle of 3 days on, one day of rest. Although CrossFit does not actively monitor the trainee’s heart rate as a measure of intensity, but ensures the same training response. “Heavy load weight training, short rest between sets, high heart rates, high intensity training, and short rest intervals, though not entirely distinct components, are all associated with a high neuroendocrine response” (Glassman 2009, 8). The majority of CrossFit workouts satisfy the 20-minute minimum to ensure adequate cardio-respiratory training effect. A select few can be finished in a shorter time, but are mainly focused on strength and power development. Only those in outstanding physical condition achieve these shorter times. Time is also utilized as a metric to gauge the intensity of the workout. The trainee’s time can be compared to thousands of other CrossFitters online. CrossFit also recommends keeping a journal and comparing times

from identical workouts as they are repeated over the weeks, months, and years. CrossFit utilizes an almost infinite combination of exercises and combinations of exercises to "regularly train past the normal motions, metabolic pathways, and modes or sports common to the athlete's sport or exercise regimen" (Glassman 2009, 7).

Principles of Exercise

"The CrossFit approach is to judiciously balance anaerobic and aerobic exercise in a manner that is consistent with the athlete's goals. Our exercise prescriptions adhere to proper specificity, progression, variation, and recovery to optimize adaptations" (Glassman 2009, 5). This quotation by CrossFit founder, Coach Greg Glassman, addresses nearly every tenet of the principles of exercise. The tenet of regularity is fulfilled utilizing 3 days of workouts followed by 1 rest day to ensure the proper mix of strength and endurance training as well as aerobic and anaerobic training.

Feasibility and Transportability

CrossFit is unique in that it can cost as little or as much as the trainee desires. Beginning CrossFitters simply follow the WOD on CrossFit.com and substitute body weight exercises for Olympic lifts and to make up for any other equipment deficiencies. Others will find a local CrossFit affiliate and pay a monthly fee to have access to all the equipment they see in the WOD, professional trainer advice and assistance, and a more communal atmosphere in which to challenge themselves. Those who get very serious construct home gyms so they have no excuse to miss a workout.

Many pieces of equipment utilized during CrossFit workouts are large and bulky and do not lend themselves to easy transport. Concept 2 Rowers, squat racks, and bars

and plate weights are a few examples. CrossFit practitioners have developed some functional ways to attain the same training effects while deployed as at home station. Most equipment can be built from material on hand. Scrap wood can be used to construct a 24 in jump box. A soccer ball can be filled with sand and then wrapped with duct tape to make a medicine ball. Other equipment can be constructed with material available in theater (see figure 11). Rocks and sand-filled ammo cans can be used in place of dumbbells, kettle bells, and weighted bars. All of these minimalist pieces of equipment can be combined to build a completely functional fitness facility (see figure 12).

Figure 11. Austere equipment [TOP]. 24in jump box and medicine ball. *Source:* Crossfit. Website. Crossfit forging elite fitness. http://crossfit.com/ (accessed 29 October 2009); Greg Glassman, Wade Rutland, JT Williams, AOFP Austere Program, http://www.crossfit.com/journal/2007/01/the_aofp_aofp_crossfit_austere_program_1.htm (accessed November 2009),

Figure 12. Rocks and Ammo Cans
Source: Crossfit, Website, Crossfit forging elite fitness, http://crossfit.com/ (accessed 29 October 2009); Greg Glassman, Wade Rutland, JT Williams, AOFP Austere Program, http://www.crossfit.com/journal/2007/01/the_aofp_aofp_crossfit_austere_program_1.htm (accessed November 2009), 1-2.

CrossFit satisfies 16 of the 17 criteria utilized to evaluate the training programs. The program is deficient in the category of specificity as defined in this thesis. CrossFit exercises do not focus specifically on particular muscles, but do address the specific combinations of muscles and movements necessary to complete functional movements. CrossFit is particularly adept at training cardio-respiratory endurance, muscular strength, and muscular endurance, and is also above average in intensity, progression, variety, and feasibility. Flexibility, frequency, and accommodations for recovery were determined to be average. CrossFit scored 12 of 17 possible points on the aforementioned evaluation criteria (see table 17).

Table 17. CrossFit Evaluation Criteria

EVALUATION CRITERIA FOR CrossFit			
Components of Fitness		Principles of Exercise	
Cardio-respiratory endurance	+	regularity	+
muscular strength	+	progression	+
muscular endurance	+	balance	+
flexibility	0	variety	+
body composition	+	specificity	-
FITT Factors		recovery	0
frequency	0	Additional Criteria	
intensity	+	feasibility	+
time	+	transportability	+
type	+	TOTAL	12

Source: Created by author utilizing Department of the Army, *Physical Fitness Training* (Washington, DC: Government Printing Office, 1998), 1-3 to 1-7.

P90X

P90X training keeps the body guessing. Trainees watch DVDs and perform variations of intense and focused workouts that keep muscles in a state of confusion. This constant variation of exercises and resulting "muscle confusion" combats boredom, prevents a plateauing of fitness gains, and is the key to the success of the P90X program. Prior to beginning the program P90X suggests completing its Fit Test.

This test confirms that the trainee possesses the minimum level of fitness necessary to benefit from the training and avoid injury. The Fit Test consists of pull-ups, vertical jump, push-ups, toe touch, wall squat, bicep curl, in and outs, and the heart rate maximizer (a 2 minute non-stop jumping jack event). P90X recommends the following minimum repetitions and weights as a baseline. Men should be able to complete 3 pull-

ups and women 1 pull-up. Vertical leap should be 5 inches and 3 inches for males and females, respectively. Women should be able to perform 3 correct push-ups and men 15. Both men and women should be no further than 6 inches from touching their toes when seated, stretching forward with straight legs. Men and women alike should also be able to hold a seated wall squat for 1 minute. Men should be able to perform 10 bicep curls with 20pounds and women 10 repetitions with 8pounds In and outs are performed seated with palms flat on the ground at your sides. Knees are bent with feet on the floor. Both men and women should be able to raise their feet off the ground, extend and straighten their legs, and return their knees to their chest 25 times. Finally, men and women should be able to perform 2 minutes of non-stop jumping jacks with a full effort surge for the final 30 seconds (Horton 2008, 17-22). Successful completion of the Fit Test qualifies the trainee to begin the full program.

Professional personal trainer Tony Horton utilizes a collection of twelve different workouts: Chest and Back, Plyometrics, Shoulders and Arms, Yoga X, Legs and Back, Kenpo X, X Stretch, Core Synergistics, Chest-Shoulders and Triceps, Back and Biceps, Cardio X, and Ab Ripper X. The twelve workouts are further organized into three distinct training blocks. These blocks consist of three weeks of intense training followed by one week of recovery. Within each of these three blocks are three distinctive phases: Adaptive Phase, Mastery Phase, and Recovery Phase. During the adaptive phase the body learns new exercises and movements. In the mastery phase the body responds to the exercises and begins to change. Finally, in the recovery phase, the body heals, grows stronger, and prepares for the next round of confusion. These three training blocks of four weeks combine for a total of 90 days, thus, the name of the program.

P90X places great importance on nutrition and produces several P90X brand supplements as well as recommending additional energy drinks and food bars produced and sold by the parent company of P90X, Beachbody. P90X is completely home-based and does not require any large lifting equipment to get the full training effect. The following are required: the 12 DVD workout system, a DVD player, a television, dumbbells, pull-up bar, resistance bands, yoga mat, and a heart rate monitor. P90X bridges the gap between FM 21-20 and TC 3-22.20 by addressing the principles of fitness and the FITT principles.

Each of the 12 P90X workouts will be broken down into its major exercises. The 12 workouts are: Chest and Back, Plyometrics, Shoulders and Arms, Yoga X, Legs and Back, Kenpo X, X Stretch, Core Synergistics, Chest/Shoulders and Triceps, Back and Biceps, Cardio X, and Ab Ripper X (Horton 2008, 7-8). Each group of exercises will then be evaluated to determine which muscles and muscle groups are recruited during its execution. These results will be recorded in the corresponding muscle utilization analysis. Each of the workouts begins with a warm-up session of moderate exercises. For the purpose of this thesis, the analysis will concentrate on the individual exercises within each workout, not the warm-ups.

Chest and Back is the first workout in P90X. The individual exercises are listed as: standard push-up, wide front pull-up, military push-up, reverse grip chin-up, wide fly push-up, closed grip overhand pull-up, decline push-up, heavy pants, diamond push-up, lawnmower, dive-bomber push-up, and back fly (Horton 2008, 38-40). This equates to 6 variations of push-ups, 3 types of pull-ups and chin-ups, 2 variations of rows, and reverse flies. This entire sequence is repeated a second time in an altered sequence (Horton 2008,

40). The Chest and Back workout trains several muscles similar to those used in similar movements to portions of Lifting from the Ground, Pulling/Climbing, and Rotation of the TRADOC 10 functional movements.

Table 18. Chest and Back Muscle Utilization

Chest and Back			
UPPER BODY		LOWER BODY	
FRONT	BACK	FRONT	BACK
anterior deltoid(S)	brachialis(A)	extensor digitorum(LL)	biceps femoris(TH)
biceps brachi(A)	brachioradialis(A)	extensor digitorum(LL)	extensor hallucis(LL)
flexor carpi radialis(A)	coracobrachialis(A)	flexor hallucis(LL)	gastrocnemius(LL)
flexor digitorum(A)	erector spinae(B)	iliopsoas(TH)	gluteus maximus(H)
medial deltoid(S)	extensor carpi radialis(A)	peroneus(LL)	semimembranosus(TH)
obliquus externus(TR)	extensor digitorum(A)	rectus femoris(TH)	semitendinosus(TH)
pectoralis major(C)	infraspinatus(B)	tibialis anterior(LL)	soleus(LL)
pectoralis minor(C)	latissimus dorsi(B)	tibialis anterior(LL)	tibialis posterior(LL)
rectus abdominus(TR)	levator scapulae(B)	vastus intermedius(TH)	
serratus anterior(TR)	posterior deltoid(S)	vastus lateralis(TH)	
sternocleidomastoid(S)	quadratus lumborum(TR)	vastus medialis(TH)	
transversus abdominus(TR)	rhomboid(B)		
	scalenes(B)		
	splenius(B)		
	subscapularis(B)		
	teres major(B)		
	teres minor(B)		
	trapezius(S)		
	triceps brachi(A)		

Source: Created by author utilizing Pat Mannochia, *Anatomy of Exercise* (New York: Firefly Books, 2008), 78-79, 82-83, 88-89, 100-101, 120-121; Tony Horton, *P90X Extreme Home Fitness-Fitness Guide* (Los Angeles: Beachbody 2009), 37-40.

Plyometrics is a series of jumping moves. 20 different exercises are executed in groups of 4 for a total of 5 blocks of exercises. Each of the 4 exercises in each block is performed for 30 seconds. Each block is performed twice, back to back, before proceeding to the next block. There is also a 30 second water break between blocks. The individual Plyometrics exercises are: Jump Squat, Run-Stance Squat, Airborne Heisman, Swing Kick, Squat Reach Jump, Run-Stance Squat Switch Pick-Up, Double Airborne Heisman, Circle Run, Jump Knee Tuck, Mary Katherine Lunge, Leapfrog Squat, Twist Combo, Rock Star Hop, Gap Jump, Squat Jack, Military March, Run Squat 180 Jump Switch, Lateral Leapfrog Squat, Monster Truck Tire, and Hot Foot (Horton 2008, 42-45). The Plyometrics workout trains several movements similar to those utilized in Rotation, Jumping and Landing, Lunging, Marching, and Change Direction of the 10 TRADOC functional movements.

Table 19. Plyometrics Muscle Utilization

Plyometrics			
UPPER BODY		LOWER BODY	
FRONT	BACK	FRONT	BACK
anterior deltoid(S)	erector spinae(B)	adductor hallucis(LL)	adductor digiti quinti pedis(LL)
biceps brachi(A)	extensor digitorum(A)	adductor longus(TH)	adductor magnus(TH)
flexor digitorum(A)	infraspinatus(B)	extensor digitorum(LL)	biceps femoris(TH)
medial deltoid(S)	latissimus dorsi(B)	extensor hallucis(LL)	flexor digitorum(LL)
obliquus externus(TR)	posterior deltoid(S)	gracilis(TH)	flexor hallucis(LL)
obliquus internus(TR)	quadratus lumborum(TR)	iliacus(TH)	gastrocnemius(LL)
rectus abdominus(TR)	rhomboid(B)	iliopsoas(TH)	gluteus maximus(H)
transversus abdominus(TR)	subscapularis(B)	pectineus(TH)	gluteus medius(H)
	teres major(B)	peroneus(LL)	piriformis(H)
	teres minor(B)	rectus femoris(TH)	quadratus femoris(TH)
	trapezius(S)	sartorius(TH)	semimembranosus(TH)
	triceps brachi(A)	tensor fasciae latae(TH)	semitendinosus(TH)
		tibialis anterior(LL)	soleus(LL)
		vastus intermedius(TH)	soleus(LL)
		vastus lateralis(TH)	tibialis posterior(LL)
		vastus medialis(TH)	trochlea tali(LL)

Source: Created by author utilizing Pat Mannochia, *Anatomy of Exercise* (New York: Firefly Books, 2008), 10-13, 36-47, 180-181; Tony Horton, *P90X Extreme Home Fitness-Fitness Guide* (Los Angeles: Beachbody, 2009), 41-45.

The individual exercises in the third workout, Shoulders and Arms, are: Alternating Shoulder Press, In and Out Bicep Curl, Two-Arm Kickback, Deep Swimmer's Press, Full Supination Concentration Curl, Chair Dip, Upright Row, Static Arm Curl, Flip-Grip Twist Triceps Kickback, Seated Two-Angle Shoulder Fly, Crouching Cohen Curl, Lying-and Down Triceps Extension (Horton 2008, 46-50). The trainee supersets all three target muscle groups, biceps, triceps, and shoulders, to both time and repetition standards that are reviewed during the workout. The Shoulders and

Arms workout trains several of the same muscles and muscle groups used in Lifting from the Ground, Pulling/Climbing, and Lifting Overhead of the TRADOC 10 functional movements.

Table 20. Shoulder and Arms Muscle Utilization

Shoulders and Arms			
UPPER BODY		LOWER BODY	
FRONT	BACK	FRONT	BACK
anterior deltoid(S)	anconeus(A)	tibialis anterior(LL)	gastrocnemius(LL)
biceps brachi(A)	erector spinae(B)	vastis medialis(TH)	gluteus maximus(H)
brachialis(A)	extensor carpi radialis(A)	vastus intermedius(TH)	soleus(LL)
brachioradialis(A)	extensor digitorum(A)	vastus lateralis(TH)	
brachioradialis(A)	infraspinatus(B)		
coracobrachialis(C)	latissimus dorsi(B)		
extensor digitorum(A)	levator scapulae(B		
flexor carpi radialis(A)	posterior deltoid(S)		
flexor digitorum(A)	quadratus lumborum(TR)		
medial deltoid(S)	rhomboid(B)		
obliquus externus(TR)	splenius(S)		
pectoralis major(C)	subscapularis(B)		
pectoralis minor(C)	supraspinatus(B)		
pronator teres(A)	teres major(B)		
scalenes(C)	teres minor(B)		
serratus anterior(TR)	trapezius(S)		
sternocleidomastoid(S)	triceps brachi(A)		
transversus abdominus(TR)			

Source: Created by author utilizing Pat Mannochia, *Anatomy of Exercise* (New York: Firefly Books, 2008), 120-123, 126-127, 132-133, 138-143, 148-149; Tony Horton, *P90X Extreme Home Fitness-Fitness Guide* (Los Angeles: Beachbody, 2009), 46-50.

Yoga X is the fourth workout in P90X and is based on the philosophy of Hatha yoga. “The more you can focus on the breath through each pose, the less you will notice the strain and discomfort” (Horton 2008, 51). The individual poses in the workout are:

Runner's Pose, Crescent Pose, Warrior One, Warrior Two, Reverse Warrior, Triangle Pose, Twisting Triangle, Chair to Twisting Chair, Right-Angle Pose To Extended Right-Angle Pose and Grab, Prayer Twist From Runner's Pose To Side Arm Balance, Warrior Three To Standing Splits, Half Moon To Twisting Half Moon, Tree, Royal Dancer, Standing Leg Extension, Crane, Seated Spinal Stretch, Cat Stretch, Frog, Bridge Or Wheel, Plough Into Shoulder Stand W/Leg Variations Into Plough, Table, Cobbler Pose, One-Legged Hamstring Stretch Into Two-Legged Hamstring Stretch, Tough The Sky, Boat, Half Boat, Scissor, Torso Twist Hold, Deep Torso, Twist Hold, Touch The Sky, Side Twist, Glute Stretch, Happy Baby, Child's Pose, Shavasana, Fetal Pose, and Meditation Pose (Horton 2008, 53-57). Yoga X is similar in its holistic training technique to that of a later workout, X Stretch. Yoga X trains the vast majority of the muscles and muscle groups used in all 10 of the TRADOC functional movements.

Table 21. Yoga X Muscle Utilization

Yoga X			
UPPER BODY		LOWER BODY	
FRONT	BACK	FRONT	BACK
anterior deltoid(S)	adductor longus(TH)	adductor longus(TH)	adductor magnus(TH)
biceps brachi(A)	erector spinae(B)	extensor digitorum(LL)	biceps femoris(TH)
brachialis(A)	extensor digitorum(A)	gracilis(TH)	gastrocnemius(LL)
brachioradialis(A)	infraspinatus(B)	iliacus(TH)	gluteus maximus(H)
coracobrachialis(C)	latissimus dorsi(B)	iliopsoas(TH)	gluteus medius(H)
extensor carpi(A)	latissimus dorsi(B)	pectineus(H)	gluteus minimus(H)
flexor carpi radialis(A)	medial deltoid(S)	peroneus(LL)	obturator externus(H)
flexor digitorum(A)	posterior deltoid(S)	rectus femoris(TH)	obturator internus(H)
obliquus externus(TR)	quadratus lumborum(TR)	sartorius(TH)	piriformis(H)
obliquus internus(TR)	rhomboid(B)	tensor fascia latae(H)	semimembranosus(TH)
pectoralis major(C)	subscapularis(B)	tibialis anterior(LL)	semitendinosus(TH)
pectoralis minor(C)	supraspinatus(B)	vastis medialis(TH)	soleus(LL)
rectus abdominus(TR)	teres major(B)	vastus intermedius(TH)	
scalenes(C)	teres minor(B)	vastus lateralis(TH)	
serratus anterior(TR)	trapezius(S)		
splenius(S)	triceps brachi(A)		
sternocleidomastoid(S)			
transversus abdominus(TR)			

Source: Created by author utilizing Pat Mannochia, *Anatomy of Exercise* (New York: Firefly Books, 2008), 100-101, 126-127, 158-161, 164-165, 170-175, 178-179; Tony Horton, *P90X Extreme Home Fitness-Fitness Guide* (Los Angeles: Beachbody, 2009), 51-57.

Legs and Back is the fifth workout in the P90X system. This workout concentrates, as the name implies, on the areas of the body that generate much of the power required from the lower body for explosive movement. The Legs and Back workout accomplishes this utilizing a combination of pull-ups, squat variations, lunges, and chin-ups. The exercises in the workout are: Balance Lunge, Calf-Raise Squat, Super Skater, Wall Squat, Wide Front Pull-Up, Step Back Lunge, Alternating Side Lunge, Closed Grip Overhand Pull-Up, Single-Leg Wall Squat, Deadlift Squat, Switch Grip Pull-

Up, Ballistic Stretch, Three-Way Lunge With Two-Kick Option, Sneaky Lunge, Reverse Grip Chin-Up, Chair Salutations, Toe-Roll Iso Lunge, Wide Front Pull-Up, Groucho Walk, Calf Raises, Closed Grip Overhand Pull-Up, 80/20 Siebers-Speed Squat, and Switch Grip Pull-Up (Horton 2008, 59-62). The Legs and Back workout trains many of the muscles used in Lifting from the Ground, Pulling/Climbing, Pushing, Jumping and Landing, Lunging, Marching, Running, and Changing Direction of the TRADOC 10 functional movements.

Table 22. Legs and Back Muscle Utilization

legs and back			
UPPER BODY		LOWER BODY	
FRONT	BACK	FRONT	BACK
anterior deltoid(S)	erector spinae(B)	extensor digitorum(A)	adductor longus(TH)
biceps brachi(A)	infraspinatus(B)	extensor hallucis(LL)	adductor magnus(TH)
brachioradialis(A)	latissimus dorsi(B)	iliopsoas(TH)	biceps femoris(TH)
extensor carpi radials(A)	levator scapulae(B)	iliopsoas(TH)	flexor hallucis(LL)
extensor digitorum(A)	posterior deltoid(S)	peroneus(LL)	gastrocnemius(LL)
flexor carpi radialis(A)	quadratus lumborum(TR)	rectus femoris(TH)	gluteus maximus(H)
medial deltoid(S)	rhomboid(B)	sartorius(TH)	gluteus medius(H)
obliquus externus(TR)	subscapularis(B)	tensor fasciae latae(TH)	piriformis(H)
obliquus internus(TR)	trapezius(S)	tibialis anterior(LL)	soleus(LL)
scalenes(C)	triceps brachi(A)	vastus intermedius(TH)	tibialis posterior(LL)
serratus anterior(TR)	teres minor(B)	vastus lateralis(TH)	tibialis posterior(LL)
sternocleidomastoid(S)	teres major(B)	vastus medialis(TH)	vastus lateralis(TH)
transversus abdominus(TR)		gracilis(TH)	
flexor digitorum(A)		adductor longus(TH)	
coracobrachialis(C)			

Source: Created by author utilizing Pat Mannochia, *Anatomy of Exercise* (New York: Firefly Books, 2008), 38-43, 48-49, 54-55, 62-62, 82-83, 88-89; Tony Horton, *P90X Extreme Home Fitness-Fitness Guide* (Los Angeles: Beachbody, 2009), 58-62.

Kenpo X is the sixth workout in the P90X program. It is based on the Kenpo Karate discipline, the first American system of martial arts (Horton 2008, 63). Although the workout recruits many of the same muscles and muscle groups used in Changing Direction, Lunging, and Rotation of the TRADOC 10 functional movements, Kenpo X is mainly a cardiovascular workout. The individual exercises are: Twist and Pivot, Twist and Pivot W/Hook, Jabs, Jab/Cross, Jab/Cross/Hook, Jab/Cross/Hook/Uppercut, Cardio Break, Step Drag/High-low Punch, Jab/Cross Switch, Hook/Uppercut Switch, Knee Kick, Ball Kick, Cardio Break, Side Kick, Back Kick, Three-Direction Kick, Side Lunge With High Sword/Low Hammer, Step/Drag/Claw/Low Punch, Cardio Break, High Block, Inward Block, Outward Block, Downward Block, Star Block, Cardio Break, Front Shuffle With High Block/Low Punch, Knee/Back Kick, Front and Back Knuckles/Ball Kick/Back Kick, Hook/Uppercut/Low Side Kick, Elbow Series, Vertical Punches, and one final Cardio Break (Horton 2008, 65-68).

Table 23. Kenpo X Muscle Utilization

Kenpo X			
UPPER BODY		LOWER BODY	
FRONT	BACK	FRONT	BACK
anterior deltoid(S)	erector spinae(B)	adductor longus(TH)	adductor longus(TH)
biceps brachi(A)	extensor carpi radialis(A)	extensor digitorum(LL)	adductor magnus(TH)
brachialis(A)	extensor carpi radialis(A)	extensor hallucis(LL)	biceps femoris(TH)
brachialis(A)	infraspinatus(B)	gracilis(TH)	gastrocnemius(LL)
brachioradialis(A)	latissimus dorsi(B)	iliopsoas(TH)	gluteus maximus(H)
coracobrachialis(C)	levator scapulae(B)	peroneus(LL)	gluteus medius(H)
extensor digitorum(A)	posterior deltoid(S)	rectus femoris(TH)	gluteus minimus(H)
flexor carpi radialis(A)	quadratus lumborum(TR)	sartorius(TH)	obturator externus(H)
flexor digitorum(A)	rhomboid(B)	semimembranosus(TH)	piriformis(H)
medial deltoid(S)	subscapularis(B)	tensor fascia latae(H)	soleus(LL)
obliquus externus(TR)	supraspinatus(B)	tibialis anterior(LL)	superior gemellus(H)
pectoralis major(C)	teres major(B)	vastus intermedius(TH)	tibialis posterior(LL)
pectoralis minor(C)	teres major(B)	vastus lateralis(TH)	
rectus abdominus(TR)	teres minor(B)	vastus medialis(TH)	
scalenes(C)	trapezius(S)		
serratus anterior(TR)	triceps brachi(A)		
splenius(S)			
sternocleidomastoid(S)			
transversus abdominus(TR)			
obliquus externus(TR)			
obliquus internus(TR)			

Source: Created by author utilizing Pat Mannochia, *Anatomy of Exercise* (New York: Firefly Books, 2008), 38-41, 50-51, 64-65, 128-129, 132-133; Tony Horton, *P90X Extreme Home Fitness-Fitness Guide* (Los Angeles: Beachbody, 2009), 63-68.

The purpose of X Stretch, the seventh workout, is to increase the trainee's flexibility by concentrating on form and breathing rather than strength or endurance. The stretch session utilizes techniques from several different disciplines beginning at the head and working down the entire body ending at the ankles. The individual stretches are: Sun Salutations, Neck Stretch, Back Up The Car, Head Roll, Expand/Contract Back-Chest-Shoulder Stretch, Topas Shoulder Stretch, Wrist-Forearm Flex, Dreya Forearm Stretch,

Arm Circles, Shoulder-Triceps Combo Stretch, Ballistic Stretches, Standing Side Stretch, Roller, Plough, Seated Spinal Stretch, Cat Stretch, Glute Stretch, Wide-Feet Forward Hamstring Stretch, Side Twist, Camel, Cat Stretch, Back Hero, Kenpo Quad Stretch, Bow, Low Squat, Frog, Seated Single-Leg Hamstring Stretch, Seated Two-Leg Hamstring Stretch, Split-Leg Hamstring Stretch, Toe Flexor, Downward Dog With Calf Stretch, Upward Dog With Ankle Stretch, and Child's Pose With Right And Left Side Stretch (Horton 2008, 69-74). X Stretch more than adequately fulfills the flexibility component of fitness by adequately stretching and preparing the vast majority of the muscles used in the execution of all 10 of the TRADOC functional movements.

Core Synergistics is the eighth workout in the P90X program. It is responsible for training arguably the most important part of the body, the core, or trunk. A strong trunk enables the generation of dynamic power and serves as the foundation for all other muscle movements. COL Christopher Toner, Commander, 3BDE/1ID recognizes the importance of training core strength in his BCT, "Core body strength should be a focused discussion as there are many modern exercises that focus on this important aspect, terrain immaterial, as we all carry heavier loads. We are focused on (training) 70 percent aerobic and 30 percent Core strength" (Toner 2010). Core Synergistics utilizes these exercises to develop the trunk and lumbar spine region: Stacked Foot/Staggered Hand Push-Up, Banana Roll, Leaning Crescent, Squat Run, Sphinx Push-Up, Bow to Boat, Low Lateral Skaters, Lunge and Reach, Prison Cell Push-Up, Side Hip Raise, Squat X-Press, Plank to Chaturanga, Walking Push-Up, Superman Banana, Lunge Kickback Curl Press, Towel Hoppers, Ballistic Stretch, Reach High and Under Push-Ups, Steam Engine, and the

Dreya Roll (Horton 2008, 75-80). The myriad muscles utilized in this workout address all 10 of the TRADOC functional movements to some degree (see table 24).

Table 24. Core Synergistics Muscle Utilization

core synergistics			
UPPER BODY		LOWER BODY	
FRONT	BACK	FRONT	BACK
anterior deltoid(S)	anconeus(A)	adductor longus(TH)	adductor magnus(TH)
biceps brachi(A)	brachialis(A)	extensor digitorum(LL)	biceps femoris(TH)
coracobrachialis(C)	brachioradialis(A)	extensor hallucis(LL)	extensor hallucis(LL)
extensor carpi radialis(A)	coracobrachialis(A)	flexor hallucis(LL)	gastrocnemius(LL)
flexor carpi radialis(A)	erector spinae(B)	gracilis(TH)	gluteus maximus(H)
flexor digitorum(A)	extensor digitorum(A)	iliacus(TH)	gluteus medius(H)
medial deltoid(S)	infraspinatus(B)	iliopsoas(TH)	gluteus minimus(H)
obliquus externus(TR)	latissimus dorsi(B)	pectineus(TH)	inferior gemellus(H)
obliquus internus(TR)	levator scapulae(B)	peroneus(LL)	obturator externus(H)
pectoralis major(C)	posterior deltoid(S)	rectus femoris(TH)	obturator internus(H)
pectoralis minor(C)	quadratus lumborum(TR)	sartorius(TH)	piriformis(H)
pronator teres(A)	rhomboid(B)	tensor fasciae latae(TH)	semimembranosus(TH)
rectus abdominus(TR)	splenius(B)	tibialis anterior(LL)	semitendinosus(TH)
scalenes(C)	subscapularis(B)	vastus intermedius(TH)	soleus(LL)
serratus anterior(TR)	supraspinatus(B)	vastus lateralis(TH)	superior gemellus(H)
sternocleidomastoid(S)	teres major(B)	vastus medialis(TH)	tibialis posterior(LL)
transversus abdominus(TR)	teres minor(B)		
	trapezius(S)		
	triceps brachi(A)		

Source: Created by author utilizing Pat Mannochia, *Anatomy of Exercise* (New York: Firefly Books, 2008), 40-43, 48-49, 100-101, 126-127, 138-139, 148-149, 160-165, 172-179; Tony Horton, *P90X Extreme Home Fitness-Fitness Guide* (Los Angeles: Beachbody, 2009), 75-80.

The ninth workout in P90X is Chest, Shoulders and Triceps. This workout utilizes a combination of push-ups, dips, flies and variations of triceps extensions to work the upper body. The individual exercises in Chest, Shoulders and Triceps are: Slow Motion

3-In-1, In and Out Shoulder Fly, Chair Dip, Plange Push-Up, Pike Press, Side Tri-Rise, Floor Fly, Scarecrow, Overhead Triceps Extension, Two Twitch Speed Push-Up, Y-Press, Lying Triceps Extension, Ballistic Stretch, Side-To-Side Push-Up, Pour Fly, Side-Leaning Triceps Extension, One-Arm Push-Up, Weighted Circle, Throw The Bomb, Clap Or Plyo Push-Up, Slow-Mo Throw, Front-To-Back Triceps Extension, One-Arm Balance Push-Up, Fly-Row Press, Dumbbell Cross-Body Blows (Horton 2008, 81-86). The Chest, Shoulders and Triceps workout trains many of the muscles used in Lifting from the Ground, Lifting Overhead, and Pushing of the TRADOC 10 functional movements.

Table 25. Chest, Shoulder and Triceps Muscle Utilization

Chest, Shoulder and Triceps			
UPPER BODY		LOWER BODY	
FRONT	BACK	FRONT	BACK
anterior deltoid(S)	anconeus(A)	extensor digitorum(LL)	soleus(LL)
biceps brachi(A)	brachialis(A)	iliopsoas(TH)	
coracobrachialis(C)	brachioradialis(A)	rectus femoris(TH)	
extensor carpi radialis(A)	erector spinae(B)	tensor fasciae latae(TH)	
flexor carpi radialis(A)	extensor digitorum(A)	tibialis anterior(LL)	
flexor digitorum(A)	infraspinatus(B)	vastus intermedius(TH)	
medial deltoid(S)	latissimus dorsi(B)	vastus lateralis(TH)	
obliquus externus(TR)	levator scapulae(B)	vastus medialis(TH)	
pectoralis major(C)	posterior deltoid(S)		
pectoralis minor(C)	quadratus lumborum(TR)		
rectus abdominus(TR)	rhomboid(B)		
scalenes(C)	splenius(B)		
serratus anterior(TR)	subscapularis(B)		
sternocleidomastoid(S)	supraspinatus(B)		
transversus abdominus(TR)	teres major(B)		
	teres minor(B)		
	trapezius(S)		
	triceps brachi(A)		

Source: Created by author utilizing Pat Mannochia, *Anatomy of Exercise* (New York: Firefly Books, 2008), 100-103, 106-107, 122-123, 126-139; Tony Horton, *P90X Extreme Home Fitness-Fitness Guide* (Los Angeles: Beachbody, 2009), 81-86.

Back and Biceps is workout number 10 in the P90X program. This workout employs multiple variations of rows, curls, and pull-ups to work the front of the arms and the back. The individual exercises of the Back and Biceps workout are: Wide Front Pull-Up, Lawnmower, Twenty-One, One-Arm Cross-Body Curl, Switch Grip Pull-Up, Elbows-Out Lawnmower, Standing Bicep Curl, One-Arm Concentration Curl, Corn Cob Pull-Up, Reverse Grip Bent-Over Row, Open-Arm Curl, Static-Arm Curl, Ballistic Stretch, Towel Pull-Up, Congdon Locomotive, Crouching Cohen Curl, One-Arm Corkscrew Curl, Chin-Up, Seated Bent-Over Back Fly, Curl Up/Hammer Down, Hammer Curl, Max Rep Pull-Up, Superman, In-Out Hammer Curl, and Strip-Set Curl. The Back and Bicep workout trains many of the muscles used in Lifting From The Ground, Pulling/Climbing, Rotation, and Changing Direction of the TRADOC 10 functional movements.

Table 26. Back and Biceps Muscle Utilization

Back and Biceps			
UPPER BODY		LOWER BODY	
FRONT	BACK	FRONT	BACK
anterior deltoid(S)	brachialis(A)	extensor digitorum(LL)	biceps femoris(TH)
biceps brachi(A)	brachioradialis(A)	flexor hallucis(LL)	extensor hallucis(LL)
flexor carpi radialis(A)	coracobrachialis(A)	iliopsoas(TH)	gastrocnemius(LL)
flexor digitorum(A)	erector spinae(B)	peroneus(LL)	gluteus maximus(H)
medial deltoid(S)	extensor carpi radialis(A)	rectus femoris(TH)	semimembranosus(TH)
obliquus externus(TR)	extensor digitorum(A)	tibialis anterior(LL)	semitendinosus(TH)
pectoralis major(C)	infraspinatus(B)	vastus intermedius(TH)	soleus(LL)
pectoralis minor(C)	latissimus dorsi(B)	vastus lateralis(TH)	tibialis posterior(LL)
rectus abdominus(TR)	levator scapulae(B)	vastus medialis(TH)	
serratus anterior(TR)	posterior deltoid(S)	adductor magnus(TH)	
sternocleidomastoid(S)	quadratus lumborum(TR)	tensor fascia latae(H)	
transversus abdominus(TR)	rhomboid(B)		
obliquus internus(TR)	scalenes(B)		
pronator teres(A)	splenius(B)		
	subscapularis(B)		
	teres major(B)		
	teres minor(B)		
	trapezius(S)		
	triceps brachi(A)		

Source: Created by author utilizing Pat Mannochia, *Anatomy of Exercise* (New York: Firefly Books, 2008), 76-79, 82-83, 88-89, 100-101, 120-121, 142-145, 172-173; Tony Horton, *P90X Extreme Home Fitness-Fitness Guide* (Los Angeles: Beachbody, 2009), 87-92.

Cardio X is the eleventh workout in the P90X program. Cardio X combines elements of the previous Yoga, Kenpo, Plyo, and Core workouts. The goal of this workout is to improve cardiovascular endurance by maintaining your heart rate below your anaerobic threshold. The individual exercises of the workout are: Sun Salutations (Vinnitsa), Runner's Pose, Warrior One, Warrior Two, Reverse Warrior, Ball Kick,

Hook/Uppercut/Side Kick, Front and Back Knuckles/Ball Kick/Back Kick, Jab/Cross/Hook/Uppercut, Three-Directional Kick, Airborne Heisman, Swing Kick, Jump Shot, Tire, Wacky Jacks, Airborne Heisman, Swing Kick, Jump Shot, Tire, Wacky Jacks, Squat X Press, Steam Engine, Dreya Roll, Squat Run, Superman/Banana. The Cardio X workout trains similar muscles to those used in Pulling/Climbing, Lifting Overhead, and Rotation of the TRADOC 10 functional movements.

Table 27. Cardio X Muscle Utilization

Cardio X			
UPPER BODY		LOWER BODY	
FRONT	BACK	FRONT	BACK
anterior deltoid(S)	brachialis(A)	extensor digitorum(LL)	adductor longus(TH)
biceps brachi(A)	brachioradialis(A)	gracilis(TH)	adductor magnus(TH)
flexor carpi radialis(A)	coracobrachialis(A)	iliacus(TH)	biceps femoris(TH)
flexor digitorum(A)	erector spinae(B)	iliopsoas(TH)	extensor hallucis(LL)
medial deltoid(S)	extensor carpi radialis(A)	pectineus(H)	gastrocnemius(LL)
obliquus externus(TR)	extensor digitorum(A)	peroneus(LL)	gluteus maximus(H)
obliquus internus(TR)	extensor digitorum(A)	rectus femoris(TH)	gluteus medius(H)
pectoralis major(C)	infraspinatus(B)	sartorius(TH)	piriformis(H)
pectoralis minor(C)	latissimus dorsi(B)	tensor fasciae latae(TH)	semimembranosus(TH)
rectus abdominus(TR)	supraspinatus(B)	tibialis anterior(LL)	semitendinosus(TH)
serratus anterior(TR)	posterior deltoid(S)	vastus intermedius(TH)	soleus(LL)
sternocleidomastoid(S)	quadratus lumborum(TR)	vastus lateralis(TH)	tibialis posterior(LL)
transversus abdominus(TR)	rhomboid(B)	vastus medialis(TH)	
	scalenes(B)		
	splenius(B)		
	subscapularis(B)		
	teres major(B)		
	teres minor(B)		
	trapezius(S)		
	triceps brachi(A)		

Source: Created by author utilizing Pat Mannochia, *Anatomy of Exercise* (New York: Firefly Books, 2008), 10-13, 38-45, 48-49, 66-67, 84-85, 88-89, 100-101, 130-131, 160-161, 164-165, 168-169, 172-175; Tony Horton, *P90X Extreme Home Fitness-Fitness Guide* (Los Angeles: Beachbody, 2009), 93-97.

Ab Ripper X is the final workout in the P90X program. In just over 16 minutes Ab Ripper X challenges the trainee with over 300 repetitions of 11 different abdominal exercises. Those exercises are: In and Out, Seated Bicycle, Seated Crunchy Frog, Crossed Leg/Wide Leg Sit-Up, Fifer Scissor, Hip Rock 'N Raise, Pulse-Up, Roll-Up/V-Up Combo, Oblique V-Up, Leg Climb, and the Mason Twist. As a strictly core workout, Ab Ripper X benefits the Rotation functional movement the most. The performance of all 10 TRADOC functional movements is enhanced, though, since the core is baseline from which power is generated and distributed to both the upper and lower body.

Table 28. Ab Ripper X Muscle Utilization

Ab Ripper X			
UPPER BODY		LOWER BODY	
FRONT	BACK	FRONT	BACK
anterior deltoid(S)	erector spinae(B)	gracilis(TH)	adductor longus(TH)
medial deltoid(S)	latissimus dorsi(B)	iliacus(TH)	adductor magnus(TH)
medial deltoid(S)	levator scapulae(B)	iliopsoas(TH)	biceps femorus(TH)
obliquus externus(TR)	posterior deltoid(S)	rectus femoris(TH)	gluteus maximus(H)
obliquus internus(TR)	quadratus lumborum(TR)	sartorius(TH)	gluteus medius(H)
pectoralis major(C)	rhomboid(B)	tensor fascia latae(H)	gluteus minimus(H)
rectus abdominus(TR)	subscapularis(B)	vastis lateralis(TH)	inferior gemellus(H)
scalenes(C)	teres major(B)	vastis medialis(TH)	obturator externus(H)
serratus anterior(TR)	teres minor(B)	vastis medialis(TH)	obturator internus(H)
splenius(S)	trapezius(S)		pectineus(H)
sternocleidomastoid(S)			piriformis(H)
transverse abdominus(TR)			semimembranosus(TH)
			semitendinosus(TH)
			superior gemellus(H)

Source: Created by author utilizing Pat Mannochia, *Anatomy of Exercise* (New York: Firefly Books, 2008), 160-165, 176-177; Tony Horton, *P90X Extreme Home Fitness-Fitness Guide* (Los Angeles: Beachbody, 2009), 98-100.

Components of Fitness

P90X subscribes to principles represented by the components of fitness. The 12 workouts are specifically designed to strive for both muscular strength and endurance. They are also of sufficient time and intensity so as to ensure cardio-respiratory endurance. One entire workout, X Stretch, is focused entirely on developing the trainee's flexibility. P90X also recognizes the importance of proper nutrition in any fitness program. "P90X isn't about restricting calories or crash diets; it's about making the proper food choices to fuel your body for maximum performance" (Horton 2008, 5). P90X also offers a complete line of supplements to augment its fitness system.

FITT Factors

P90X falls just outside 3-5 workouts per week outlined in FM 21-20. P90X utilizes a 6 days on, 1 day off frequency of training. Although not required, P90X recommends that the trainee actively monitor his heart rate during exercise to maintain optimal performance. 10 of the 12 P90X workouts exceed the 20-minute minimum to ensure cardio-respiratory training effect. The other 2 exercises, Ab Ripper X and Stretch X, have specific goals other than cardio-respiratory training. Each workout is timed and the trainee is directed when to switch exercises, grips, sides, etc. P90X recommends keeping a training log so the trainee can track his progress as he increases his number of performed repetitions, uses more weight, etc. P90X uses an eclectic collection of different training methods to challenge the trainee with a variety of methods. "Any time you present your body with a new physical challenge, it must learn to develop a new set of 'engrams,' which are neuromuscular patterns developed in order to do the new movements" (Horton 2008, 3). This forcing the body to constantly re-learn or, muscle

confusion precludes any plateauing of training effects. Variety of training methodology assists in this endeavor.

Principles of Exercise

P90X addresses all 7 of the principles of exercise: overload, progression, regularity, variety, recovery, balance, and specificity. Each of the 10 strength and endurance workouts pushes the trainee to muscle overload. There is a natural progression as the trained records his results and seeks to better his efforts with each workout. The trainee is working out 6 of every 7 days in numerous different disciplines followed by a designated recovery day. Muscular strength and endurance are balanced while each workout focuses on specific body areas.

Feasibility and Transportability

P90X has a start-up cost. The program can be ordered online for $69.99. Where the costs begin to add up is with the additional equipment that is recommended: heart rate monitor-$75, chin-up bar-$65, Plyometrics mat-$90, and resistance bands-$40. The trainee incurs additional costs if he utilizes any of the available nutritional supplements. The P90X program is very transportable, just a packet of DVDs and a small booklet. Either a DVD player and TV or a laptop computer will also be required. Where transportability can pose a challenge is with the supplemental equipment, mainly the resistance training equipment. Resistance bands do not take much room, but dumbbells and/or kettle bells are bulky and heavy. This is less of a concern on major bases in forward operational theaters where gyms have grown to rival facilities enjoyed at home

station. Equipment availability is more of a challenge in remote areas where facilities are austere or non-existent.

Table 29. Evaluation Criteria for P90X

EVALUATION CRITERIA FOR P90X			
Components of Fitness		Principles of Exercise	
Cardio-respiratory endurance	+	regularity	+
muscular strength	+	progression	+
muscular endurance	+	balance	+
flexibility	+	variety	+
body composition	0	specificity	+
FITT Factors		recovery	0
frequency	0	Additional Criteria	
intensity	+	feasibility	0
time	-	transportability	0
type	+	TOTAL	10

Source: Created by author utilizing Department of the Army, *Physical Fitness Training* (Washington, DC: Government Printing Office , 1998), 1-3 to 1-7.

Army Physical Readiness Training

The Army's new Physical Readiness Training (PRT) program has one main focus, developing physical readiness. "The purpose of the PRT Program is to develop and maintain a high level of unit physical readiness appropriate to duty position and for the conduct of full spectrum operations" (U.S. Department of the Army 2010, 4-9). Physical readiness is further defined as, "the ability to meet the physical demands of any combat or duty position, accomplish the mission and continue to fight and win" (U.S. Department of the Army 2010, 1-1). Train as you fight has been the mantra in myriad training arenas

in the Army, but not to the extent that the Army's new physical readiness doctrine combines the philosophies of current Army Regulations (AR), Field Manuals (FM), and Training Circulars (TC). "All Army training is based on the principle "Train as you will fight." Therefore, the primary focus of PRT goes far beyond preparation for the Army Physical Fitness Test (APFT)" (U.S. Department of the Army 2010, 1-3). Warrior Tasks and Battle Drills modified on 25 March 2010 (Alley 2010) are now directly linked to the physical skills required to successfully complete them (see table 30).

Table 30. Warrior Tasks and Battle Drills

Shoot	***Physical Requirements***
Employ hand grenades	Run under load, jump, bound, high/low crawl, climb, push, pull, squat, lunge, roll, stop, start, change direction, get up/down and throw.
Move	***Physical Requirements***
Perform individual movement techniques	March/run under load, jump, bound, high/low crawl, climb, push, pull, squat, lunge, roll, stop, start, change direction and get up/down.
Navigate from one point to another	March/run under load, jump, bound, high/low crawl, climb, push, pull, squat, lunge, roll, stop, start, change direction and get up/down.
Move under fire	Run fast under load, jump, bound, crawl, push, pull, squat, roll, stop, start, change direction and get up/down.
Survive	***Physical Requirements***
Perform Combatives	React to man-to-man contact: push, pull, run, roll, throw, land, manipulate body weight, squat, lunge, rotate, bend, block, strike, kick, stop, start, change direction and get up/down.
Adapt	***Physical Requirements***
Assess and Respond to Threats (Escalation of Force)	React to man-to-man contact: push, pull, run, roll, throw, land, manipulate body weight, squat, lunge, rotate, bend, block, strike, kick, stop, start, change direction and get up/down. Run under load, jump, bound, high/low crawl, climb, push, pull, squat, lunge, roll, stop, start, change direction, get up/down and throw.
Battle Drills	***Physical Requirements***
React to contact	Run fast under load, jump, bound, crawl, push, pull, squat, roll, stop, start, change direction and get up/down.
Evacuate a casualty	Squat, lunge, flex/extend/rotate trunk, walk/run, lift and carry.

Source: Department of the Army, *Army Physical Readiness Training* (Washington, DC: Government Printing Office, 2010), 1-4.

Physical Readiness Training is broken down into three phases: Initial Conditioning, Toughening Phase, and Sustaining Phase. These separate phases directly

correlate with the 3 phases of ARFORGEN: Reset, Train/Ready, and Available. They also align with the professional progression of soldiers' careers: Future Soldiers, Initial Military Training (IMT), and Unit PRT. Initial Conditioning introduces those interested in the Army (Future Soldiers and ROTC cadets) to the concept of PRT and prepares them for the physical challenges of IMT and duty in the Army. The Toughening Phase develops the foundation for fitness and introduces IMT trainees, Basic Combat Training (BCT), One Station Unit Training (OSUT), and the Basic Officer Leader Course B (BOLC B), to the 10 critical skills they must be able to perform: Lifting from the ground, Lifting overhead, Pushing, Pulling/Climbing, Rotation, Jumping and Landing, Lunging, Marching, Running, and Change Direction. The Sustaining Phase PRT builds on gains made in the Toughening Phase and increases resistance to maintain high levels of physical readiness during Unit PRT.

Eight exercise drills were evaluated from the multitude available exercises in *APRT*. The exercise of running was also evaluated. A brief description of each exercise is followed by its body segments trained analysis. Individual muscle utilization and subsequent grouping into body segments trained had already been conducted during the construct of *APRT*. For that reason, body segments trained charts are shown rather than the muscle utilization charts previously used.

Conditioning Drill 1 (CD 1) is first drill of 8 in the Mobility Drills and Activities workout. CD 1 consists mainly of basic and intermediate calisthenics that train strength, endurance and mobility with functional movements. The individual exercises within CD 1 are: Power Jump, V-Up, Mountain Climber, Leg-Tuck and Twist, and the Single-Leg

Push-Up. CD 1 trains many of the muscles used in Lifting from the Ground, Pushing, Rotation, and Jumping and Landing of the 10 TRADOC functional movements.

Table 31. Conditioning Drill 1 (CD 1) Body Segments Trained

CONDITIONING DRILL 1 (CD 1)	MUSCLES							
	HIPS	THIGHS	LOWER LEGS	CHEST	BACK	TRUNK	SHOULDERS	ARMS
1. POWER JUMP	X	X	X		X	X	X	
2. V-UP	X	X	X		X	X	X	X
3. MOUNTAIN CLIMBER	X	X	X	X	X	X	X	X
4. LEG TUCK AND TWIST	X	X	X		X	X	X	X
5. SINGLE LEG PUSH-UP	X	X	X	X	X	X	X	X

Source: Department of the Army, *Army Physical Readiness Training* (Washington, DC: Government Printing Office, 2010), 9-5.

The second drill is Conditioning Drill 2 (CD 2). CD 2 exercises increase in intensity utilizing complex movements to build the muscle strength and endurance needed to perform Warrior Tasks (WT) and Battle Drills (BD). The individual exercises in the CD2 workout are: Turn and Lunge, Supine Bicycle, Half Jacks, Swimmer, and 8-Count Push-Ups. CD 2 trains many of the muscles used in Lifting from the Ground, Pushing, and Lunging of the 10 TRADOC functional movements.

Table 32. Conditioning Drill 2 (CD 2) Body Segments Trained

CONDITIONING DRILL 2 (CD 2)	MUSCLES							
	HIPS	THIGHS	LOWER LEGS	CHEST	BACK	TRUNK	SHOULDERS	ARMS
1. TURN AND LUNGE	x	x	x	x	x	x	x	x
2. SUPINE BICYCLE	x	x	x	x	x	x	x	x
3. HALF JACKS	x	x	x		x	x	x	
4. SWIMMER	x	x	x		x	x	x	x
5. 8-COUNT PUSH-UP	x	x	x	x	x	x	x	x

Source: Department of the Army, *Army Physical Readiness Training* (Washington, DC: Government Printing Office, 2010), 9-12.

Conditioning Drill 3 (CD 3) is the third drill. CD 3 is conducted much like CD 1 and CD 2, but with increased intensity and difficulty. CD 3 employs several jumping and landing exercises with an increased focus on the legs and lower legs. The individual exercises in CD 3 are: “Y” Squat, Single-Leg Dead Lift, Side-to-Side Knee Lifts, Front Kick Alternate Toe Touch, Tuck Jump, Straddle-Run Forward and Backward, Half-Squat Laterals, Frog Jumps Forward and Backward, Alternate 1/4-Turn Jump, and the Alternate Staggered Squat Jump. CD 3 trains many of the muscles used in Rotation, Jumping and Landing, Marching, and Changing Direction of the 10 TRADOC functional movements.

Table 33. Conditioning Drill 3 (CD 3) Body Segments Trained

CONDITIONING DRILL 3 (CD 3)	MUSCLES							
	HIPS	THIGHS	LOWER LEGS	CHEST	BACK	TRUNK	SHOULDERS	ARMS
1. "Y" SQUAT	X	X	X		X	X	X	X
2. SINGLE-LEG DEAD LIFT	X	X	X		X	X		
3. SIDE-TO-SIDE KNEE LIFTS	X	X	X	X	X	X	X	
4. FRONT KICK ALTERNATE TOE TOUCH	X	X	X	X	X	X	X	X
5. TUCK JUMP	X	X	X	X	X	X	X	X
6. STRADDLE-RUN FORWARD AND BACKWARD	X	X	X			X		
7. HALF-SQUAT LATERALS	X	X	X	X	X	X	X	X
8. FROG JUMPS FORWARD AND BACKWARD	X	X	X	X	X	X	X	X
9. ALTERNATE 1/4 – TURN JUMP	X	X	X	X	X	X	X	X
10. ALTERNATE-STAGGERED SQUAT JUMP	X	X	X		X	X	X	

Source: Department of the Army, *Army Physical Readiness Training* (Washington, DC: Government Printing Office, 2010), 9-20.

The Push-Up and Sit-Up Drill (PSD) is the fourth drill. This drill builds upper body strength and develops the core. PSD is the one drill specifically designed to enhance performance on the Army Physical Fitness Test (APFT). The 2 exercises in the drill are

the push-up and sit-up and are performed as per the APFT standards. PSD trains many of the muscles used in Pushing and Rotation of the 10 TRADOC functional movements.

Table 34. Push-Up and Sit-Up Drill (PSD) Body Segments Trained

PUSH-UP AND SIT-UP DRILL (PSD)	MUSCLES							
	HIPS	THIGHS	LOWER LEGS	CHEST	BACK	TRUNK	SHOULDERS	ARMS
1. PUSH-UP	X	X	X	X	X	X	X	X
2. SIT-UP	X	X	X		X	X	X	X

Source: Department of the Army, *Army Physical Readiness Training* (Washington, DC: Government Printing Office, 2010), 9-38.

The fifth drill is Climbing Drill 1 (CL 1). CL 1 This trains both the muscles and techniques needed to successfully climb and negotiate complex obstacles. This includes core and lower body exercises as well as upper body training. The individual exercises in CL 1 are: Straight-Arm Pull, Heel-Hook, Pull-Up, Leg Tuck, and Alternating Grip Pull-Up. CL 1 trains many of the muscles used in Pulling/Climbing and Rotation of the 10 TRADOC functional movements.

Table 35. Climbing Drill 1 (CL 1) Body Segments Trained

CLIMBING DRILL 1 (CL 1)	MUSCLES							
	HIPS	THIGHS	LOWER LEGS	CHEST	BACK	TRUNK	SHOULDERS	ARMS
1. THE STRAIGHT-ARM PULL					X	X	X	X
2. HEEL HOOK	X	X	X	X	X	X	X	X
3. PULL-UP					X	X	X	X
4. LEG TUCK	X	X	X	X	X	X	X	X
5. ALTERNATING GRIP PULL-UP				X	X	X	X	X

Source: Department of the Army, *Army Physical Readiness Training* (Washington, DC: Government Printing Office, 2010), 9-42.

Climbing Drill 2 (CL 2) is the sixth drill in Strength and Mobility Drills and Activities. CL 2 utilizes the same 5 exercises as in CL 1: Flexed-Army Hang, Heel Hook, Pull-Up, Leg Tuck, and Alternating Grip Pull-Up. Resistance is increased in the performance of these exercises by performing them in LBE/LBV, body armor, and individual weapon. Like CL 1, CL 2 trains the muscles used in Pulling/Climbing and Rotation of the 10 TRADOC functional movements, but with added difficulty and realism due to the increased resistance.

Table 36. Climbing Drill 2 (CL 2) Body Segments Trained

CLIMBING DRILL 2 (CL 2)	MUSCLES							
	HIPS	THIGHS	LOWER LEGS	CHEST	BACK	TRUNK	SHOULDERS	ARMS
1. FLEXED-ARM HANG					X	X	X	X
2. HEEL HOOK	X	X	X	X	X	X	X	X
3. PULL-UP					X	X	X	X
4. LEG TUCK	X	X	X	X	X	X	X	X
5. ALTERNATING GRIP PULL-UP				X	X	X	X	X

Source: Department of the Army, *Army Physical Readiness Training* (Washington, DC: Government Printing Office, 2010), 9-48.

Strength Training Circuit (STC) is the drill number 7. STC combines a climbing drill, a military movement drill, and kettle bell exercises in a whole body exercise to develop strength and mobility. The individual exercises in the STC are: Sumo Squat, Straight-Leg Dead Lift, Forward Lung, Step-Up, Pull-Up or Flexed-Arm Hang, Supine Chest Press, Bent-Over Row, Over-Head Press, Supine Body Twist, and the Leg Tuck. STC trains the muscles used in Lifting From the Ground, Lifting Overhead, Pushing, Pulling/Climbing, Rotation, Lunging, and Marching of the 10 TRADOC functional movements.

Table 37. Strength Training Circuit (STC) Body Segments Trained

STRENGTH TRAINING CIRCUIT (STC)	MUSCLES							
	HIPS	THIGHS	LOWER LEGS	CHEST	BACK	TRUNK	SHOULDERS	ARMS
1. SUMO SQUAT	X	X	X	X	X	X	X	X
2. STRAIGHT-LEG DEAD LIFT	X	X	X		X	X	X	X
3. FORWARD LUNGE	X	X	X	X	X	X	X	X
4. STEP-UP	X	X	X		X	X	X	X
5. PULL-UP OR FLEXED-ARM HANG					X	X	X	X
6. SUPINE CHEST PRESS				X	X	X	X	X
7. BENT-OVER ROW					X	X	X	X
8. OVER-HEAD PUSH-PRESS	X	X	X	X	X	X	X	X
9. SUPINE BODY TWIST	X	X	X	X	X	X	X	X
10. LEG TUCK	X	X	X	X	X	X	X	X

Source: Department of the Army, *Army Physical Readiness Training* (Washington, DC: Government Printing Office, 2010), 9-54.

The Guerrilla Drill (GD) is eighth drill. The GD develops leg power and coordination that are then applied in lifting a Soldier. The 3 exercises in the GD are: Shoulder Roll, Lunge Walk, and Soldier Carry. GD trains the muscles used in Lifting from the Ground and Lifting Overhead of the 10 TRADOC functional movements.

Table 38. Guerrilla Drill (GD) Body Segments Trained

GUERRILLA DRILL (GD)	MUSCLES							
	HIPS	THIGHS	LOWER LEGS	CHEST	BACK	TRUNK	SHOULDERS	ARMS
1. SHOULDER ROLL	X	X	X	X	X	X	X	X
2. LUNGE WALK	X	X	X		X	X	X	
3. SOLDIER CARRY	X	X	X	X	X	X	X	X

Source: Department of the Army, *Army Physical Readiness Training* (Washington, DC: Government Printing Office, 2010), 9-70.

Running is the final exercise evaluated in the PRT program. As stated earlier in this thesis, the U.S. Army has made a conscious decision to overhaul its approach to running as well as other endurance and mobility activities. Additional attention has been paid to anaerobic training and its benefits, particularly with the focus on WTBD and their inherent need for short, explosive power, and anaerobic endurance.

Table 39. Endurance and Mobility Activities

Endurance and Mobility Activities	
Military Movement Drills 1 and 2 (MMD 1&2)	These drills dynamically prepare the body for more vigorous running activities and develop motor efficiency.
30:60s and 60:120s	30:60s and 60:120s improve the resistance to fatigue of the active muscles by repeatedly exposing them to high intensity effort. As a result of their increased anaerobic and aerobic endurance, Soldiers will be able to sustain performance of physically demanding tasks at a higher intensity for a longer duration.
300-yard Shuttle Run (SR)	The 300-yard Shuttle Run develops the ability to repeatedly sprint after changing direction. It is an indicator of the Soldier's anaerobic endurance, speed and agility.
Hill Repeats (HR)	Hill repeats are an effective means of developing explosive leg strength, anaerobic power and speed.
Ability Group Run (AGR)	Ability group runs train Soldiers in groups of near-equal ability to sustain running for improvement in aerobic endurance.
Unit Formation Run (UFR)	Unit formation runs are based on a time and distance that can be achieved with unit integrity and a display of unit cohesion.
Release Run (RR)	Combine the benefits of formation running and individual performance at higher training intensities. Soldiers will run in formation to a specified time (no more than 15 minutes), then are released to run as fast as they can back to the starting point.
Terrain Run (TR)	Terrain running applies the *Train as you will fight* principle to PRT. Running through local training areas, over hills and around obstacles improves mobility, endurance and the ability to stop, start, and change direction.
Foot March (FM)	Foot marching as a movement component of maneuver, is a critical Soldier physical requirement. Regular foot marching prepares Soldiers to successfully move under load.
Conditioning Obstacle Course (CDOC)	Running the conditioning obstacle course for time challenges Soldiers' strength, endurance and mobility, improving individual movement techniques.
Endurance Training Machines (ETM)	Use of endurance training equipment may be based on environmental constraints, safety for Soldiers on physical profile and isolation of specific muscle groups to be trained during rehabilitation and reconditioning.

Source: Department of the Army, *Army Physical Readiness Training* (Washington, DC: Government Printing Office, 2010), 10-2.

Like the other exercises, running in all forms is now aligned with the Toughening Phase and successive, increasingly challenging levels of the Sustaining Phase. These temporal classifications provide structure for Soldiers as they enter the Army and progress through their careers. The classifications also provide guidance on how to structure physical training to best take advantage of time available during the various stages of ARFORGEN.

Table 40. Endurance and Mobility Activities Prescription

Endurance and Mobility Activities					
Activities	**Toughening Phase** (BCT&OSUT-R/W/B)	**Sustaining Phase** (AIT&OSUT-B/G)	**Sustaining Phase ARFORGEN** (Reset)	**Sustaining Phase ARFORGEN** (Train/Ready)	**Sustaining Phase ARFORGEN** (Available)
MMD 1	1 rep	1 rep	1 rep	1 rep	1 rep
MMD 2	N/A	1 rep	1 rep	1 rep	1 rep
30:60s	6-8 reps	6-10 reps w/wo load	6-10 reps w/wo load	10-15 reps w/wo load	10-15 reps w/wo load
60:120s	6-10 reps	6-10 reps	6-10 reps	6-10 reps	6-10 reps
300-yd SR	1 rep	1-2 reps w/wo load	1-2 reps	1-2 reps w/wo load	1-2 reps w/wo load
HR	N/A	6-8 reps uphill or downhill	6-10 reps uphill or downhill	6-10 reps uphill or downhill	6-10 reps uphill or downhill
AGR	10-30 min	20-30 min	10-30 min	10-30 min	10-30 min
UFR	20-30 min	20-30 min	30 min	30 min	30 min
RR	20-30 min	20-30 min	30 min	30 min	30 min
TR	N/A	20 min	20-30 min	20-30 min	20-30 min
FM	2-15 Km	2-15 Km	10 Km or less	10-30 Km	10-30 Km
CDOC	1 rep	1 rep	1 rep	1 rep	1 rep
ETM	N/A	N/A	20-30 min	20-30 min	20-30 min
Abbreviations	MMD-Military Movement Drill UFR-Unit Formation Run CDOC-Conditioning Obstacle Course	SR-Shuttle Run RR-Release Run ETM-Endurance Training Machines	HR-Hill Repeats TR-Terrain Run	AGR-Ability Group Run FM-Foot March (fl/aml/eaml)	

Source: Department of the Army, *Army Physical Readiness Training* (Washington, DC: Government Printing Office, 2010), 10-3.

Components of Fitness

The PRT program utilizes the Components of Training in its training philosophy. The Components of Training are strength, endurance, and mobility. Strength speaks directly to muscular strength and muscular endurance so those two components of fitness are included in the PRT program. Endurance deals with both aerobic and anaerobic training and conditioning so cardio-respiratory endurance is also addressed. Two areas that receive less attention are flexibility and body composition. Flexibility is one of the PRT Components listed under the mobility component of training, but other than its casual mention in the description of several drills, flexibility receives little other

coverage. Body composition suffers much the same fate. There is a brief reference to using low or non-weight bearing training equipment to increase the caloric expenditure of overweight Soldiers, but nothing further. *APRT* instead defers to AR 600-9, *The Army Weight Control Program*, for clarity on the topic.

Frequency, Intensity, Time, and Type Factors

PRT Principles are the 'new' FITT factors in the PRT program. The PRT Principles are: Precision, Progression, and Integration. Precision speaks to the adhering to standards of execution to ensure maximum results for effort given. Progression details "the systematic increase in intensity, duration, volume, and difficulty of PRT activities" (U.S. Department of the Army 2010, 2-3). These four criteria correlate with frequency, intensity, and time of the FITT Principles. Integration mentions use of multiple training activities to ensure proper recovery times. Integration also discusses training component movements of WTBD during PRT sessions. This covers the same information previously found in the "type" principle of FITT.

Principles of Exercise

PRT addresses all 7 of the principles of exercise: overload, progression, regularity, variety, recovery, balance, and specificity. As the Soldier's physical acumen improves, the Soldier performs PRT exercises and drills organized into specific categories and phases. This ensures progression takes place at a sustainable rate and minimizes injury. PRT sessions are conducted during duty hours, utilizing multiple drills and exercises, and are conducted to muscle failure with appropriate recovery times. These characteristics fulfill the requirements of regularity, variety, overload, and recovery.

Balance and specificity are also built-in to the PRT program. Workouts rotate between strength and endurance training. Within endurance training, aerobic endurance, anaerobic endurance, and cardiovascular endurance are all developed. Individual exercises and collections of drills are specifically designed to build the necessary physical capacity for Soldiers to perform WTBD.

Feasibility and Transportability

The only Soldier costs to conduct PRT are time and sweat. The Army provides the necessary facilities and equipment to conduct all training sessions. For the majority of forward deployed theaters, the Army has also solved the transportability problem. As discussed earlier, gyms on major bases in forward operational theaters have grown to rival facilities enjoyed at home station. More challenging are the remote areas where facilities are austere or non-existent.

Table 41. Evaluation Criteria for PRT

EVALUATION CRITERIA FOR PRT			
Components of Fitness		Principles of Exercise	
Cardio-respiratory endurance	+	regularity	+
muscular strength	+	progression	+
muscular endurance	+	balance	0
flexibility	-	variety	+
body composition	0	specificity	+
FITT Factors		recovery	+
frequency	+	Additional Criteria	
intensity	+	feasibility	+
time	+	transportability	+
type	+	TOTAL	13

Source: Created by author utilizing the Department of the Army, *Physical Fitness Training* (Washington, DC: Government Printing Office, 1998), 1-3 to 1-7.

Phase 4 Comparisons

Components of Fitness, FITT Factors, Principles of Exercise, Feasibility, and Transportability

The following 3 charts contain the analysis data for each training program measured against the criteria established in phase 1 (see tables 42, 43, and 44). A (+) score is above average, a (0) score is average, and a (-) score is below average. A perfect score would be 17. CrossFit scored (+) in 13 criteria, (0) in 3 criteria, and (-) in 1 criterion. This resulted in an overall score of 12. CrossFit's was awarded a score of (-) in specificity since the program defines itself by not training on any specific task or discipline. P90X scored (+) in 12 criteria, (0) in 3 criteria, and (-) in 2 criteria. This resulted in an overall score of 10. P90X was awarded a score of (-) in both time and feasibility. The average exercise in P90X lasts 57 minutes and the start-up cost of the program is the highest of the 3 evaluated. PRT scored (+) in 14 criteria, (0) in 3 criteria, and (-) in 1 criterion. This resulted in an overall score of 13. PRT was awarded a score of (-) in flexibility. The PRT program best meets the established evaluation criteria comprised of the Components of Fitness, FITT Factors, Principles of Exercise, Feasibility, and Transportability.

Table 42. Evaluation Criteria for CrossFit

EVALUATION CRITERIA FOR CrossFit			
Components of Fitness		Principles of Exercise	
Cardio-respiratory endurance	+	regularity	+
muscular strength	+	progression	+
muscular endurance	+	balance	+
flexibility	0	variety	+
body composition	+	specificity	-
FITT Factors		recovery	0
frequency	0	Additional Criteria	
intensity	+	feasibility	+
time	+	transportability	+
type	+	TOTAL	12

Source: Created by author utilizing the Department of the Army, *Physical Fitness Training* (Washington, DC: Government Printing Office, 1998), 1-3 to 1-7.

Table 43. Evaluation Criteria for P90X

EVALUATION CRITERIA FOR P90X			
Components of Fitness		Principles of Exercise	
Cardio-respiratory endurance	+	regularity	+
muscular strength	+	progression	+
muscular endurance	+	balance	+
flexibility	+	variety	+
body composition	0	specificity	+
FITT Factors		recovery	+
frequency	0	Additional Criteria	
intensity	+	feasibility	-
time	-	transportability	0
type	+	TOTAL	10

Source: Created by author utilizing the Department of the Army, *Physical Fitness Training* (Washington, DC: Government Printing Office, 1998), 1-3 to 1-7.

Table 44. Evaluation Criteria for PRT

EVALUATION CRITERIA FOR PRT			
Components of Fitness		Principles of Exercise	
Cardio-respiratory endurance	+	regularity	+
muscular strength	+	progression	+
muscular endurance	+	balance	0
flexibility	-	variety	+
body composition	0	specificity	+
FITT Factors		recovery	+
frequency	+	Additional Criteria	
intensity	+	feasibility	+
time	+	transportability	+
type	+	TOTAL	13

Source: Created by author utilizing Department of the Army, *Physical Fitness Training* (Washington, DC: Government Printing Office, 1998), 1-3 to 1-7.

10 Functional Movements

The following is a comparison of the abilities of the 3 programs to train the proper muscles and muscle groups to enable the successful completion of the 10 TRADOC critical tasks: Lifting from the Ground, Lifting Overhead, Pushing, Pulling/Climbing, Rotation, Jumping and Landing, Lunging, Marching, Running, and Changing Direction. These tasks are critical because they are the individual movements required to successfully complete the WTBD. Each of these critical tasks was broken down into the individual muscles required for the task's successful completion. Exercises within each of the programs were then analyzed at the same muscular level. This determined which programs were training which muscles and if they were effectively addressing the 10

critical tasks. These lists of muscles were then grouped into 'body segments trained' to allow easier comparison (see tables 45, 46, 47).

All 3 programs successfully train the 8 body segments used as evaluation criteria: Hips, Thighs, Lower Legs, Chest, Back, Trunk, Shoulders, and Arms. The PRT program distinguished itself from both CrossFit and P90X in that each of its individual drills and circuits trained all 8 of the body segments. Admittedly this is by design. The various drills, circuits, and exercises in the PRT program were all designed to build on each other and culminate in building the physical capacity required to successfully complete the 10 critical functional movements.

Table 45. CrossFit - Body Segments Trained

CrossFit	MUSCLES							
	HIPS	THIGHS	LOWER LEGS	CHEST	BACK	TRUNK	SHOULDERS	ARMS
1. WEIGHTED LUNGE/WEIGHTED PULL-UP		X			X			X
2. NANCY		X	X		X		X	
3. FIGHT GONE BAD	X	X		X	X		X	X
4. SIDE WALLBALL TOSS/SHUTTLE RUN	X	X	X		X	X	X	

Source: Created by author utilizing Department of the Army, *Army Physical Readiness Training* (Washington, DC: Government Printing Office, 2010), 8-2.

Table 46. P90X - Body Segments Trained

P90X	MUSCLES							
	HIPS	THIGHS	LOWER LEGS	CHEST	BACK	TRUNK	SHOULDERS	ARMS
1. CHEST & BACK				X	X			X
2. PLYOMETRICS	X	X			X	X	X	
3. SHOULDERS & ARMS					X		X	X
4. YOGA X	X	X		X	X	X		
5. LEGS & BACK		X	X		X			
6. KENPO X	X	X	X		X	X	X	X
7. X STRETCH	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
8. CORE SYNERGISTICS	X	X	X	X	X	X	X	X
9. CHEST, SHOULDERS & TRICEPS				X	X		X	X
10. BACK & BICEPS		X			X	X	X	X
11. CARDIO X	X	X	X		X	X	X	X
12. AB RIPPER X	X	X			X	X		

Source: Created by author utilizing Tony Horton, *P90X Extreme Home Fitness-Fitness Guide* (Los Angeles: Beachbody, 2009); Department of the Army, *Army Physical Readiness Training* (Washington, DC: Government Printing Office, 2010), 8-2.

Table 47. PRT - Body Segments Trained

PRT	MUSCLES							
	HIPS	THIGHS	LOWER LEGS	CHEST	BACK	TRUNK	SHOULDERS	ARMS
1. CONDITIONING DRILL 1 (CD 1)	X	X	X	X	X	X	X	X
2. CONDITIONING DRILL 2 (CD 2)	X	X	X	X	X	X	X	X
3. CONDITIONING DRILL 3 (CD 3)	X	X	X	X	X	X	X	X
4. PUSH-UP/SIT-UP DRILL (PSD)	X	X	X	X	X	X	X	X
5. CLIMBING DRILL 1 (CL 1)	X	X	X	X	X	X	X	X
6. CLIMBING DRILL 2 (CL 2)	X	X	X	X	X	X	X	X
7. STRENGTH TRAINING CIRCUIT (STC)	X	X	X	X	X	X	X	X
8. GUERILLA DRILL (GD)	X	X	X	X	X	X	X	X

Source: Created by author utilizing Department of the Army, *Army Physical Readiness Training* (Washington, DC: Government Printing Office, 2010); Department of the Army, *Army Physical Readiness Training* (Washington, DC: Government Printing Office, 2010), 8-2.

In conclusion, this chapter has analyzed the three physical training programs utilizing 2 separate sets of criteria. The first was comprised of the Components of Fitness, FITT Factors, Principles of Exercise, Feasibility, and Transportability. The first 3 were derived from timeless exercise principles and the last 2 were included to examine the financial burden on the Soldier and whether he would be able to use the program both at home station and while deployed. The PRT program had the highest rating of the 3 programs. The second set of criteria was based on the muscles necessary to perform the TRADOC critical 10 functional movements. First, the TRADOC functional movements were broken down according to the muscles required for their completion. These muscles were then grouped into “body segments trained” to enable easy comparison of the

programs. Next, each program was broken down in a similar manner to determine the "body segments trained." This data was then recorded in 3 tables allowing a side-by-side comparison of the 3 fitness programs. As previously mentioned, the PRT program again came out on top.

Does the Physical Readiness Training program adequately prepare the Army for the rigors of combat? Upon the completion of the analysis and comparison of the results, the answer is clear. Yes. The PRT best addresses the individual exercises that are crucial to the successful completion of the TRADOC critical tasks. These tasks, in turn, are key to the individual Soldier's ability to successfully complete WTBD. Is there room for improvement? The answer is again, yes. The next chapter will discuss in greater detail recommendations to improve the new PRT program and aid its assimilation.

CHAPTER 5

CONCLUSIONS AND RECOMMENDATIONS

The newly published *Army Physical Readiness Training* has, for the first time since 1989, successfully integrated effective physical training paradigms and balanced their application within a doctrinal framework that accounts not only for physical fitness training, but also leadership, training in general, and the ARFORGEN process.

All three programs studied in the completion of this thesis meet the criteria utilized to determine an effective PT program. The PRT program best meets these criteria while developing the necessary muscular strength, muscular endurance, and cardiovascular endurance to best complete the 10 critical TRADOC movements. These 10 movements are, in turn, the building blocks to successful completion of the new Warrior Tasks and Battle Drills (WTBD). It is the ability to train these required incremental steps that defines the nature of PRT and makes it truly battle-focused.

P90X also develops muscular endurance, and cardiovascular endurance, but is more focused on fitness than on developing strength and power. Both of these are critical to effectively executing WTBD. CrossFit develops muscular endurance, muscular strength, and cardiovascular endurance, but is reliant on some specialty skills and training techniques (power lifting, gymnastics, etc.) that require certification to teach and time to learn. CrossFit does develop the power and strength required to effectively complete the WTBD. PRT combines the holistic fitness training of P90X and the ability to develop explosive power of CrossFit into a collection of simple drills and exercises that can adapt to as much or as little equipment as the trainee has available.

As the Army shifts its focus from general fitness to true battle focused physical training, what are some additional areas for leader consideration?

A Culture of Physical Fitness

As leaders in the Army begin to incorporate the drills and exercises in the new PRT manual replacing those in the old FM 21-20 series, there will also need to be a purging of the minimalist attitude that has become a part of our unofficial physical training culture. Too many times as leaders we here the same question immediately prior to the conduct of the APFT, "How many do I need to pass?" Rather than focusing on numbers of push-up and sit-up repetitions and 2-mile run times, leaders need to develop their unit's ability to successfully complete specified sets of complex body movements that enable success in combat situations. COL Henry Arnold III, 4 IBCT, 1ID, stated it best, "Soldiers are combat systems, and the gym and the PT field is the motor pool and maintenance facility for that combat system. Fitness is an integral part of readiness and survivability on the battlefield" (Arnold 2010). This, necessarily, then begs the question: If training fundamentals have been modified to develop different, focused sets of physical skills, why has the assessment tool remained unchanged?

APFT Modification

For the first time since 1998 the Army has fundamentally altered its approach to fitness training. Why hasn't the APFT been modified to properly assess these new skills? The new PRT recognizes several new requirements that cannot be properly assessed utilizing the current APFT: upper body strength (Pulling/Climbing), explosive leg power (Lifting from the Ground, Jumping and Landing, Lunging), and core strength (Rotation,

Lifting from the Ground, Lifting Overhead, Pulling/Climbing). The APFT could continue as a measure of general fitness, but an additional, combat-focused test should be administered to assess the 10 identified TRADOC tasks. The USMC has successfully instituted such a test, the Combat Fitness Test (CFT). The CFT tests all 10 of the TRADOC physical tasks utilizing a combination of 3 events: the 880 yd run, ammo can lifts, and a composite event called maneuver under fire (U.S. Marine Corps 2010). This additional test could be administered annually, or, as Dr. Richard Olsen suggests, could be included in either the train/ready or available phase of the ARFORGEN cycle (Olsen 2010). Either way the Army could accurately measure the skills it has identified as critical to mission success. Much like the PRT, this would require additional training.

Physical Training Education

As a nation at war for the past 9 years, the frequency and intensity of physical training has suffered due to OPTEMPO. As a result, Soldiers, NCOs, and officers are reporting to new units in less than optimal physical shape. This challenge will only be exacerbated as the Army begins to institute its new PRT program. Instruction on the new PRT must be included in IET, the NCOES, and OES courses and schools. “Overall, we lack well-trained leaders at the company level who have graduate knowledge of physical fitness methodology and TTPs” (Toner 2010). Exposing Soldiers and leaders to the PRT program as part of the Army’s professional curriculums is the first step in inculcating a culture of physical excellence. Show them how to do it correctly and then hold them to an exacting standard. As an adjunct to official education and the electronic and printed versions of the PRT manual, an interactive Army fitness website would also be useful. The web-based format would enable easy updates in an ever-changing field. Videos of

new drills and exercises, a frequently asked question section, and printable PT pocket guides are all tools that Soldiers and leaders would use. Young Soldiers and leaders increasingly turn to the web for information, so why not provide the information in a medium they understand and prefer.

In conclusion, the recent introduction of the Army Physical Readiness Training program presents a unique opportunity for the Army to re-establish a culture of physical excellence. By utilizing multiple methods of education and instituting new APFT assessment standards, the Army can begin, as an organization, to focus on the physical skills required to ensure success in combat.

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